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DECENTRALIZED AUTONOMOUS ORGANIZATION AS A DISRUPTIVE INNOVATION IN INSURANCE INDUSTRY

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ABSTRACT

Rosa Siliämaa: Decentralized autonomous organization as a disruptive innovation in insurance industry
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Blockchain technology has raised a lot of discussions within academia as well as in financial industry. The founder of Ethereum, Vitalik Buterin, was first to introduce the idea of decentralized autonomous organization (DAO), in which blockchain and smart contracts are used to form a new kind of organization. This concept is at the center of this study: could DAO disrupt the insurance industry?

DAO in this thesis is referred to as a system which utilizes transparent blockchain technology and smart contracts while being both governed and owned in a decentralized manner. This qualitative research focuses on providing a comprehensive view on DAO's potential in insurance industry on a conceptual level. The findings combine expertise gathered from 17 informants in semi-structured interviews. This research describes the changes in insurance value chain. Additionally, several possibilities for DAO utilization in insurance industry were identified. The DAO potential is also reviewed from the perspective of a disruptive innovation, as the main research question of this study aims to understand the disruptive potential (if there is such) of DAO in insurance industry.

The main finding of this research is that DAO's disruptive potential in insurance industry cannot be completely denied. However, there are still many open questions which stem from mindset change, regulation, governance, social construction, consumer perspective, quality of information, and technological maturity. The study did not find challenges that would have been seen as unsolvable barriers for DAO adoption. Furthermore, markets where DAO would not have any potential could not be identified. Another key finding concerns how DAO could affect insurance value chain — in essence, DAO has potential to affect all parts of the insurance value chain, depending on the chosen implementation strategy.

Based on this research, DAO seems to have manifold potential in insurance industry. Three main categories arose from the expert interviews regarding opportunities to exploit DAO in insurance: (1) peer-to-peer insurance models, (2) new markets, and, most notably, (3) existing companies could also act as DAO exploiters. Specifically, it seems that existing companies may utilize DAOs in three different ways: (1) as internal startup for certain products, (2) as an entity to which a particular part of the value chain is outsourced to, and (3) in a way, we don't know yet.

Keywords: decentralized autonomous organization, blockchain, smart contracts, insurance industry, disruption in insurance industry, digitalization

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The journey continues,
Rosa Siliämaa

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1 INTRODUCTION

1.1 Research background and key concepts

Justice Hugo Black wrote in 1943: "*Perhaps no modern commercial enterprise directly affects so many people in all walks of life as does the insurance business. Insurance touches the home, the family, and the occupation or business of almost every person in the United States."* (Dorfman & Cather 2013, 80). Insurance affects many people's ordinary life and that life may be influenced as megatrends such as automation and digitalization shape the industry.

Eling and Lehmann (2018) have studied the impact of digitalization[1] on the insurance value chain. In their research one of the obvious changes considered the automation of business processes (such as automated processing of contracts and automated reporting of claims) and decisions (such as automated underwriting, claim settlement and product offerings) (Eling & Lehmann 2018). As the level of automation rises, could it be possible to form an end-to-end automated insurance-like processes that would also include automation of the governance in these systems?

In 2008 Satoshi Nakamoto introduced a new way of organizing trade in a decentralized manner (Nakamoto 2008). The Bitcoin network can be considered as the first truly autonomous organization governed exclusively by a decentralized consensus protocol that anyone can freely adopt (Shermin 2018). It is likely that the world will see many different use cases and purposes for these kind of decentralized autonomous organizations (DAOs[2]) in the future that evolve on top of the technology that Bitcoin first pioneered (Olpinski 2016). Could some of these use cases and purposes belong to the insurance sector?

Studies have found multiple use cases for blockchain technology and smart contracts in insurance industry (see chapters 1.3 and 2.4.2). Some indications that DAOs could have potential in insurance industry have also been made. For example, Gatteschi, Lamberti, Demartini, Pranteda, & Santamaría (2018) suggest that in insurance industry blockchain and smart contracts could enable a shift to a full decentralization by e.g. automating the management of funds in self-insured groups. Also, Mehar, Shier, Giambattista, Gong, Fletcher, Sanayhie and Laskowski (2019) use insurance as an example to illustrate

[1] Digitalization can be characterized as the use of new technologies to industrialize and automize processes, to change the communication between customer and insurer, and to generate and evaluate new data. (Tischhauser, Naumann, Candreia, Treier and Senser 2016)

[2] In this research DAO is referred as an automated organization that utilizes blockchain technology and smart contracts (see chapter 3.5).

the functionality of smart contracts through organizations such as in the blockchain project called "The DAO"[3]. Following these discussions, this study aims to seek what are the use cases for DAO in insurance (if any) in a more detailed level.

As the area of blockchain and DAO is fairly new, the usage of central terms is diverse. Therefore, the Table 1 describes what is meant by these concepts in this research.

Table 1 - Key concepts

CONCEPT	DEFINITION
Organization	Organizations are systems of coordinated action among individuals and groups whose preferences, information, interests or knowledge differ. Organization theories describe the delicate conversion of conflict into cooperation, the mobilization of resources and the coordination of effort that facilitate the joint survival of an organization and its members (March and Simon 1993: 2).
Digitalization	Digitalization can be characterized as the use of new technologies to industrialize and automize processes, to change the communication between customer and insurer, and to generate and evaluate new data. (Tischhauser, Naumann, Candreia, Treier and Senser 2016)
Decentralization	"*A decentralized system is where some decisions by the agents are made without centralized control or processing."* (Johnson 1999)
Autonomy	A state where one is able to make significant decisions without the consent of others (Brock 2003).
Innovation	Innovation = new idea + execution + value creation (Ståhle, Sotarauta and Pöyhönen 2004, 11).
Disruptive innovation	A process in which new entrants challenge incumbent firms, often despite inferior resources. (Hopp, Antons, Kaminski and Salge 2018, 446)
Blockchain	A database type that is distributed, shared and cryptographically protected. Each block is always chained to the next block using a cryptographic signature. (Walport 2016)
Smart contract	A self-executing computer code that contains pre-programmed rules that apply to parties to a contract. For example, a smart contract can be used in a blockchain. (Lauslahti & Mattila & Seppälä 2016)
Decentralized autonomous organization (DAO)	In this thesis Decentralized Autonomous Organization is defined as a transparent organization that is managed and owned in a decentralized manner and where administrative rules are formalized, automated, and implemented with software that utilizes blockchain technology and smart contracts.

[3] "The DAO" was a blockchain project (see chapter 3.4) and should not be confused with the general term DAO (decentralized autonomous organization).

1.2 Research objectives, research questions and scope

This thesis aims to form a better understanding of DAO's potential in insurance industry. Voshmgir Shermin (2017) has stated that DAO has a potential to disrupt governance as we understand it today. Therefore, special attention will be given to DAO's disruptive potential in insurance environment.

Main research question:

What is the disruptive potential of decentralized autonomous organization (DAO) in insurance industry?

Sub-questions:

1. What is the impact of DAO to the insurance value chain?
2. How does DAO align with the characteristics of a disruptive innovation?
3. In which insurance markets does DAO have potential opportunities, if any?
4. What are the main conceptual challenges for DAO adoption?

The main question is divided into four sub-questions. After these sub-questions have been answered it is expected that answering to the main question is possible. The first sub-question concerns the impact of DAO to the insurance value chain. In order to understand DAO's potential in insurance industry, I believe it is necessary to first better understand what DAO means in the context of insurance and how DAO could shape the value chain, as it might have impact on the potential opportunities. In order to understand DAO's disruptive potential, it needs to be viewed from the perspective of disruptive innovation (a concept founded by Clayton Christensen, 1997). Therefore, that is set as the second sub-question. The third sub-question aims to understand characteristics of the insurance markets where DAO could have potential. As Gatteschi et al. (2018) have stated, insurance markets could have such potential in peer-to-peer insurance, but what are the constraints (if any) and is that the only potential use case? If this research would only answer to these questions, the probability of the potential to be realized may appear as too optimistic. Therefore, the fourth sub-question is added in order to understand the main conceptual challenges for DAO adoption. If such challenges can be found that would dramatically affect to the likelihood of DAO adoption, it will also affect to the disruptive potential of DAO as a whole.

To answer these sub-questions, I will use both theorical and empirical information. Description of theoretical material is addressed in chapter 1.3. The empirical material is collected from 17 expert interviews and the more detailed description of the method can be found from chapter 4. The first sub-question will be answered purely by the empirical material. The second sub-question needs theory of disruptive innovation to be compared to characteristics of DAO. It's assumed that empirical findings would form an understanding what DAO is from the insurance market point of view. After I have

gathered this understanding, it is possible to compare if it satisfies the characteristics of a disruptive innovation. The third question will also utilize both theoretical material and empirical findings, although the emphasis lies with empirical side. Empirical findings are expected to offer opportunities to answer to fourth question as well, and this will be enriched by theoretical material.

The scope of this research is to remain on a conceptual level and not to dive deeper into technical problems that DAO may have. This study looks DAO as a separate phenomenon from the insurance industry's point of view. The study has no geographical delimitation as it would not have been meaningful due to the nature of DAO — therefore, limitations of the specific operating environment are not taken into account. Instead, the characteristics of the environment for DAO's are searched through the third sub-question.

1.3 Literature review and earlier researches

As DAO builds up on blockchain technology and smart contracts, understanding the ongoing scientific discussions around these topics is needed. Additionally, insurance theories are addressed in chapter 2 as they create the framework for this study, from which the insurance value chain is the central element and it also provides a basis for interview questions. Lastly, as this study aims to form an understanding of DAO's disruptive potential, the theory of a disruptive innovation by Christensen is assessed in chapter 2.5.

Blockchain technology has been widely discussed topic during last years. Governments and companies around the world are experimenting this new technology trying to figure out its applications and potential. Blockchain has aroused particular interest in financial sector and new consortiums have been established for developing solutions for this sector (e.g. R3[4], we.trade[5], B3i[6], RiskStream Collaborative[7]). In academia, blockchain has been widely discussed as well and in 2014 a journal for blockchain and related subjects was established (Ledger 2019).

Blockchain in all of its forms is expected to possess a large amount of business value in the future. Gartner (2017) forecasts that by 2030 blockchain business value will exceed USD 3,1 trillion. Blockchain is said to have potential in all forms of trading where trust is essential and identity security is needed (Plansky, O'Donnell, & Richards, 2016). In corporate environment, blockchain's potential shows up in optimizing business processes in situations where registering and transferring any type of

[4] https://www.r3.com
[5] https://we-trade.com
[6] https://b3i.tech/home.html
[7] https://www.theinstitutes.org/guide/riskstream-collaborative

asset is needed (Brenig, Schwarz, & Rückeshäuser, 2016). As discussed in chapter 2, these are some of the core functions in insurance, which indicates that insurance might benefit from this technology.

Utilization of blockchain technology and smart contracts in insurance has been subject for research over many years and it has been seen to offer potential in many ways. Gatteschi et al. (2018) have suggested that blockchain and smart contracts can be utilized in insurance industry to speed up claims processing, reduce operating costs, fraud prevention, pay-per-use insurance, identity identification, and peer-to-peer insurance. Crawford (2017) notes that blockchain will enable the insurance company to set up an operational system that can handle and enforce claims almost immediately, without any manual work. The same applies to insurance applications and insurance renewal requests (Crawford 2017).

Since 2008, when Satoshi Nakamoto (2008) introduced Bitcoin, blockchain has emerged in various forms, often allowing records of transactions automatically make further transactions when blockchain participants reach consensus on those transactions. This has enabled the rise of functions called smart contracts – automated and self-forced digital contracts on immutable ledger. It is believed that this technology could disrupt the business and financial services as the internet disrupted off-line commerce. (Cong & He 2018) One potential way for this disruption to emerge could be innovation called decentralized autonomous organization (DAO) — a complex set of smart contracts to form a new kind of organization (Shermin 2017).

DAO has been encountered in literature as an innovation that utilizes computerized rules and contracts (Chohan 2017g; Dupont 2017; Jentzsch 2016; Norta, Othman & Taveter 2015; Norta 2016; Swan 2017) which are used to eliminate governmental roles in an organization (Mehar et al. 2019). It has been seen as capable to organize similar or the same functions as the most traditional forms of organization (Lauslahti, Mattila, Seppälä 2017). One of the most studied DAO projects has been “The DAO”, which had an intent to serve as a platform for investors to invest directly in certain kind of blockchain projects (Dupont 2017). More detailed description of DAO in scientific discussion can be found in chapter 3.4.

1.4 Theoretical and conceptual framework

Theory can be seen as a starting point for interpretation and discussion, as a point of view as well as a base for new theories (Hirsijärvi & Hurme 2011, 40). This research aims to examine the phenomena of DAO in the context of existing theories and aims not to build a new theory. The research utilizes conceptual and interpretation theory as shown in figure 1. Conceptual theory creates a frame for research, which is needed in order to understand the results of the study. Conceptual theory can be seen as a start point for interpretation. A selected phenomenon is being examined from the point of view framed by interpretation theory. (Eskola & Suoranta 2014, 82)

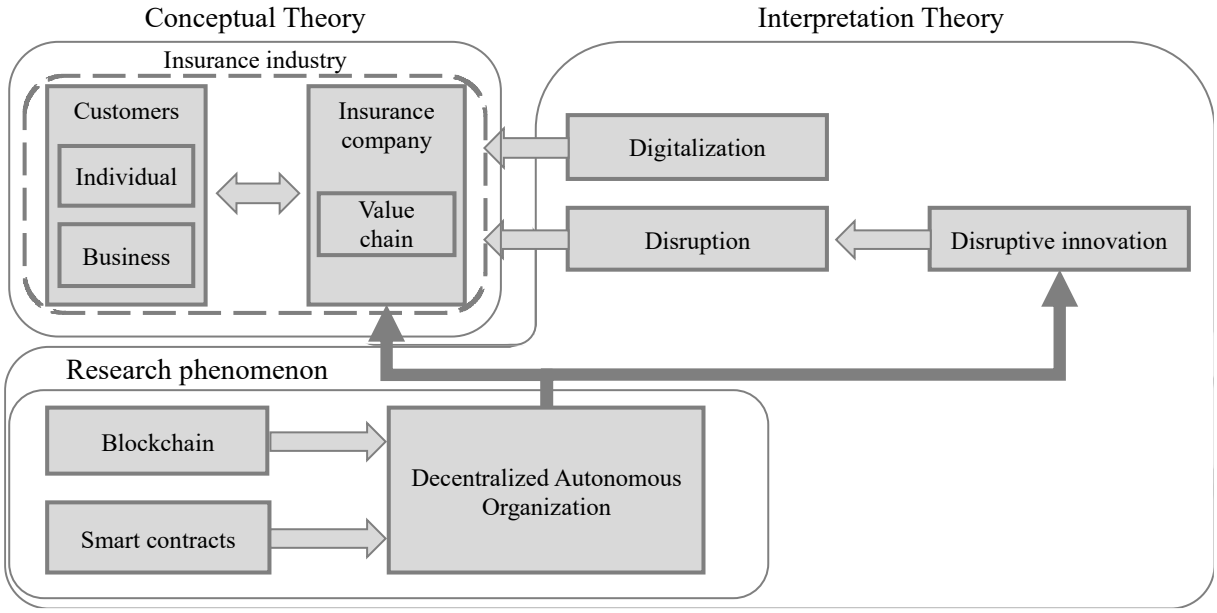

Figure 1 - Theoretical framework

As this research examines innovation that affects how an insurance company organizes its activities, understanding of insurance company's operation as a whole is needed. Therefore, insurance company's value chain and operating environment must be taken into account. In framework this is described as insurance industry. Customers are seen as the most vital stakeholder for the company, and the changing needs of the customers have a strong impact on insurance company's operation.

Relevant forces in context of this research identified to transform the operation are digitalization and disruption. Digitalization has had a strong and continuous changes for insurance companies and customers, and as DAO may also be seen as being part of digitalization it has been selected. Disruption is selected, as this research studies DAO's disruptive potential. Insurance industry is more susceptibility for the future disruption than industries on average (Abbosh, Savic, and Moore 2018). Disruption may occur due to disruptive innovation and is therefore linked to it.

Blockchain and smart contracts are strongly affecting to DAO as it builds on them (See chapter 3). Blockchain and smart contracts are seen necessary for DAO operation and therefore this study examines DAO by building on their theory. In chapter 3 DAO is addressed in more detail.

The research question builds in between of these two entities: DAO and insurance industry (see the dark arrow in Figure 1). Thus, the study aims to understand what is the potential that DAO holds for insurance industry from insurance companies' point of view. Furthermore, this study aims to understand if that potential can be seen as disruptive or not.

1.5 Thesis structure

The theoretical part of this thesis is divided into two chapters: (1) INTRODUCTION TO INSURANCE INDUSTRY AND DISRUPTIVE INNOVATION and (2) DECENTRALIZED AUTONOMOUS ORGANIZATION. These chapters form a basis for understanding the empirical findings. The first chapter covers the environment where this research takes place and description of the disruptive innovation. The second chapter covers the phenomenon in question. Empirical findings will be encountered in chapter 5 and lastly follows the discussion part.

The first theoretical chapter will go through foundational insurance theories and also innovation theories. The first subchapter 2.1 presents characteristics of insurance, which forms the frame for this study and DAO's conceivable potential. In chapter 2.2 the insurance value chain is presented. This helps to categorize DAO's potential in insurance value chain level and is used as a part of the interview question. Chapter 2.3 deepens the understanding what it is like for organization to act on insurance markets from the competitional and other challenges point of view. Chapter 2.4 creates the background for technological trends relevant for this study and leads reader to the chapter 3. The last subchapter 2.5 presents innovation theories from which DAO is analyzed in this study. As DAO is examined form the disruptability point of view, the last subchapter describes innovation theories to be utilized and also looks into disruption in insurance industry. This is necessary in order to answer to the first research sub-question.

The second theoretical chapter (chapter 3) focuses on creating an understanding of DAO. As described earlier in chapter 1.4 blockchain and smart contracts are seen vital tools for DAO. Therefore, they are needed to be concerned before an understanding of DAO can be created. As 3.1 and 3.2 subchapters describe the technology behind the DAO, the chapter 3.3 describes a business level example so that deeper understanding of DAO can be formed. Chapter 3.4 gathers separately what literature has said about DAO. As DAO is still rather new term, the chapter 3.5 seeks to summarize what the term means in this study.

Methodology is described in chapter 4. First the interview structure has been explained in chapter 4.1. The description of interviews and experts are addressed in chapter 4.1. Informants have been anonymized because this was believed to increase the quality of the research. However, a description of the individual informants' background in provided in chapter 4.2 as well as the description of the interviews. Lastly, the chapter 4.3 describes the methodology used in analysis.

The chapter 5 is the empirical part of this study and contains all of the insights gathered from the interviews. In chapter 5.1 informants' definition of DAO is presented. In order to have comparable

point of views, it was important to make clear that the informants have understood the concept of DAO somewhat similarly and as it may differ from the theoretic definition it is addressed first. The rest of the empirical subchapters are formed to answer to the sub-research questions. Chapter 5.2 describes section by section what is the believed impact of DAO to the insurance value chain on a high level. Informants raised up some differences between DAO and traditional insurance organization and these aspects are introduced in chapter 5.3. In chapter 5.4 the disruptive potential of DAO is presented and in chapter 5.5 perceived challenges and barriers for DAO adoption is presented. Lastly chapter 5.6 presents what the DAO looks from the regulative perspective.

Discussion takes its place in chapter 6 where the focus is answering to the research questions. Additionally, research valuation and critique are addressed in chapter 6.2 and suggestions for future research are presented in chapter 6.3. Lastly, the conclusion can be found from chapter 7.

2 INTRODUCTION TO INSURANCE INDUSTRY AND DISRUPTIVE INNOVATION

This chapter sets background for this study through the main theories. This chapter is divided into two parts: insurance and disruption. As insurance creates the main frame for this study, we will go through some foundational insurance theories and a slight amount of its history in order to understand the industry environment. We will also go through high-level limitations concerning operation in insurance industry in order to later compare if DAO is able to satisfy these conditions. The second main background theory is formed around disruption. First (as DAO's disruptive potential is being studied), we will approach disruptive innovation in chapter 2.5.1. In order to better understand the disruptive potential, we will lastly assess disruption in insurance context.

2.1 Introduction to insurance

Insurance can be understood in economics so that one actor is willing to pay another for risk transfer. The core concept of insurance is that the policyholder agrees with the insurer that if a certain risk is realized in the future, the insurer will compensate for the insured person or the damage to his or her property in accordance with the insurance contract. In return for this, the policyholder pays the insurer an insurance premium. (Rantala & Pentikäinen 2009, 61) Insurance is one of the most important ways in which individuals and communities protect themselves against financial harm. (Dorfman & Cather 2013, 80)

Not all risks can be transferred to insurance company. In order for risk to be insurable, it needs to satisfy four conditions. First (1) condition: The risk must be the same for a large enough group, and it must appear independently and identically and be of such significance that it arouses interest in insurance. Second (2) condition: The damage must be defined in time, place, value and cause. Third (3) condition: The loss likely to occur over a certain period of time should be highly predictable and expected loss should be calculable. Fourth (4) condition: From the insurers point of view the loss should be fortuitous. Additionally, to these four conditions it is vital that insured payoff is not greater than the loss incurred. In the opposite case the insurance will create an incentive to cause the insured event to occur. In this situation, both moral hazard and adverse selection are revealed. (Williams, Smith & Young, 1998, 384-385)

Insurance products can be divided into life and non-life insurances. (Skipper & Kwon 2007, 529; Rantala & Kivisaari 2016, 81; Dorfman & Cather 2013, 86) Life insurance covers damage occurred for insured

person such as physical damage or death and non-life insurance compensates for material damage such as damage to a house or other asset. From the regulatory perspective insurance companies are divided based on their insurance offerings. For example, in Finland insurance company cannot offer both life and non-life insurance but have to choose between these two and some separate regulations have been set for both activities (Act on Insurance Companies 18.7.2008/521, 3§).

Life insurance history dates back over 2,500 years to societies in Greek, but it became more common in 16th century. At that time life insurances were peer-to-peer based. Individuals served as insurers or as trusted parties. In the late 17th first modern insurance companies were created which had adequate mortality statistics and therefore they were able to create the early actuarial principles for group insurance. Life insurance products were fairly simplified. Policies involved only life contingencies, which means that the compensation was paid solely on the basis of whether the insured was alive or dead. (Skipper & Kwon 2007, 529-530) Since then life insurance products have become more complex. Today, life insurance policies offered by insurance companies can be divided into four categories: (1) death, (2) living to a certain age, (3) incapacity, (4) injury or disease. The first two are mortality based and the latter two are morbidity based. It is not uncommon that modern products may include features from both mortality and morbidity-based policies. (Skipper & Kwon 2007, 530) Current products may therefore be rather complex. Today life insurance can be purchased by individuals or organizations (Black & Skipper 2000).

Non-life insurance has even longer history than life insurance: it can be traced back almost 4000 years to Babylonians and Chinese. The first distinct nonlife insurance policies seem to be originated from 14th century in Genoa, Italy. The real impetus for the nonlife insurance markets happen in 16th century due to The Great Fire of London in 1666. The first modern nonlife insurance company The Fire Office was created in 1680. (Skipper & Kwon 2007, 567) In modern days OECD (2003) classifies nonlife insurance into 9 categories: (1) motor vehicle, (2) marine, aviation and transportation (MAT), (3) freight, (4) fire and other property damage, (5) pecuniary loss, (6) general liability, (7) accident and sickness, (8) other nonlife insurance and (9) treaty insurance.

2.2 Insurance value chain

For the presentation of results in this research we use the following conceptual framework. Value chain is a framework originally developed by Porter (1985) to describe how company is creating value for its customers. Rahlfs (2007) shaped Porter's framework into insurance specific form in 2007 (Figure 2). This framework has also been used by Eling and Lehmann (2018) in their research on the impact of digitalization in insurance industry.

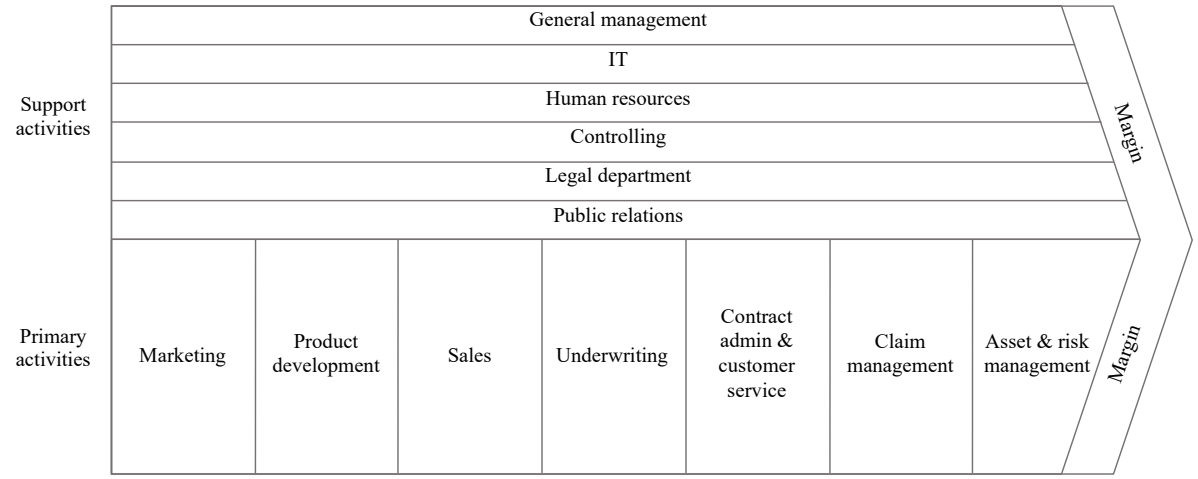

Figure 2 - Insurance-specific value chain
Porter (1985) and Rahlfs (2007)

The value chain contains primary activities and support activities. Primary activities are processes where the product is designed, manufactured, and delivered to the customer. In insurance value chain primary activities contain marketing, product development, sales, underwriting, contract admin & customer service, claim management and asset & risk management. Support activities support the primary activities and other support activities. In insurance support activities include general management, IT, human resources, controlling, legal department and public relations (Figure 2). In each category there are some main tasks to be conducted. Eling and Lehmann (2018) have specified these tasks and they are listed in Table 2.

Table 2 - Tasks in insurance value chain
(adapted from Eling and Lehmann 2018)

VALUE CHAIN PROCESS	TASKS
Primary activities	
Marketing	• Market and customer research: researching ideas for product development • Analyzing target groups • Development of pricing strategy for product sales • Designing of advertisement and communication strategies
Product development	• ‘‘Manufacturing’’ the products • Product pricing (actuarial methods) • Check legal requirements
Sales	• Customer acquisition, consultation • Product sale • After-sales
Underwriting	• Application handling • Risk assessment • Assessment of the final contract details, if necessary, ask for more information
Contract administration/ customer service	• Change of contract data • Answering customer requests regarding the contract or other purposes
Claims management	• Investigation of fraud • Claim settlement
Asset management	• Asset allocation • Asset liability management
Risk management	• Analysis and management of all risks
Support activities	
General management	• Strategic planning and implementation of company goals
IT	• IT procurement (hard-/software) and installation • IT service • IT support • IT development • Coordination of IT processes
Human resources	• Planning HR development • Job interviews • Job market advertisement • Job training
Controlling	• Data capture and analysis • Reporting • Business-KPI measurement
Legal department	• Dealing with legal effects
Public relations	• Press/investor management

In a value chain model, a product or service runs through the entire value chain from start to end, adding value at each stage of the value chain until it ultimately reaches the customer, who is sold at a price higher than the cost of production, thereby achieving margins. The more effectively a product's value to the customer can be increased in the value chain by adding value to the product being produced step by step, the higher the return on the product produced. On the other hand, the growing profit margin of the value chain improves the company's profitability. The value generated by in-house operations can be measured directly from the price that customers are willing to pay for the product or service of the company. The company is profitable if it manages to provide value to the customer at lower production and support costs. In this way, value chain activities can be seen as building blocks of competitive

advantage and their cost performance depends on how well the company performs in the cost competition market. (Porter 1985)

2.3 Competition and challenges in the insurance markets

In order for competitive insurance markets to exist, following four conditions have to be met. (1) A large number of buyers and sellers, so that a single player is not able to influence the price. In most modern insurance markets, this condition is satisfied. (2) The market also needs to have freedom to entry and to exit the market. This condition is satisfied in almost markets. (3) According to third condition sellers need to offer identical or fully substitutable products. Current insurers focus widely in product differentiator. While from the customers perspective it may seem like all the insurance companies offer the same products. (4) The fourth and last condition is well-informed buyers and sellers. (Dorfman & Cather, 2013, 129-130)

The last condition mentioned above is not easy to fully achieve in insurance markets due to information asymmetry. The information asymmetry has major adverse impacts on insurance business. These impacts can be split into moral hazard and adverse selection. Moral hazard impact results from dependency of actions of insured. As a result of adequate insurance cover, insurance may take riskier chooses that could lead to increased probability of loss and the amount of loss. (Zweifel & Eisen 2012, 267-268)

One of the biggest risks of insurance company is the random variation of the amount of the reimbursement expense at different times. (Rantala & Pentikäinen 2009, 149–150) Pooling risks, i.e. merging risks, reduces the volatility of claims and therefore a large insurance company has a smaller variation in the cost of damage than a smaller insurance company. (Harrington & Niehaus 2003, 61–62) In insurance, the benefits of scaling are obvious because of the law of large numbers[8] which provides benefits due to decentralization of risk (Dorfman & Cather 2013, 84-85, 92).

Some of the most important obstacles to success in the insurance industry are high entry barriers. The barrier to entry can be defined as any factor that hinders entry and reduces or restricts competition (Organisation for Economic Co-operation and Development, 2007). According to Porter, critical market barriers include economies of scale, product differentiation, capital requirements, customer switching

[8] Law of large numbers belongs to probability theory, and it is a theorem that describes the result of performing the same experiment a large number of times. According to the law, the average of the results obtained from a large number of trials should be close to the expected value and will tend to become closer as more trials are performed. (Hacking 1983)

costs, access to distribution channels, non-scale cost disadvantages, and government policy barriers (Porter 2004, 7–13).

The insurance risk transfer value chain suffers from drag coefficient and a troubling trust deficit. These issues in turn contribute to underinsurance and leave many risks completely uninsured. For example, only 17% of Californian households own earthquake insurance, despite its likelihood and household's scarce resources. This is partly due to false assumptions about the likelihood of earthquakes and also due to high costs and inefficient delivery models of insurance companies. (Disparte 2017)

2.4 Trends in insurance industry relevant to this study

Digitalization/automation and blockchain have been selected as trends to be presented since they are strongly related to this study. Digitalization is a megatrend that can be seen as a big headline under which this research belongs. DAO is possible due to digitalization and automation as will be further discussed in chapter 3. Blockchain—the underlying technology of DAO—has been widely discussed in insurance industry for a while now and in literature many different opportunities for utilizing blockchain technology has been suggested. These aspects need to be understood in order to compare empirical findings into theory. Peer-to-peer insurance has also been a discussed area during last years and insurance DAO has been linked to it in many occasions (see e.g. Nexus & Teambrella).

2.4.1 Digitalization and automation in insurance industry

Digitalization is a widely used term to describe transformation of knowledge into computing language—ones and zeroes. Digitalization makes it easier and faster to transfer data and it has leaded to growing amount of innovations in insurance industry (Brynjolfsson and McAfee 2014, 57; Vuorinen 2014, 5). While digitalization has strongly transformed several industries (see e.g. Moreau 2013 on the music industry or Chathoth 2007 on the travel industry; additionally, Back et al. 2016 and Kane, Palmer, Phillips, Kiron & Buckley 2015 is referred for cross-industry comparisons on the importance of digitalization) in insurance industry digitalization has come rather late (Eling & Lehmann 2018) and it is it believed that we haven't yet seen utilization of the full potential of digital technologies in insurance industry (Catlin, Hartmann, Segev, Ido & Tentis 2015).

Digitalization is a megatrend that holds several emerging digital technologies within. Eling and Lehmann (2018) have conducted a research on the impact of digitalization in insurance value chain and they have divided digital technologies into artificial intelligence, big data, internet of things, blockchain, cloud computing, mobile devices with apps, chatbots, robo-advisors, social network (facebook) / messenger (whatsapp) / internet forum, video calls (skype, facetime), video platforms (youtube, vimeo)

and website. They have crystallized the most significant impacts deriving from these technologies into three changes. The first is the way insurance companies communicate with their clients. In the past, the use of personal contact was common when buying insurance, but to an increasing extent, customers can handle all communication directly with the systems on websites or in mobile apps. (Eling & Lehmann 2018)

The second major and obvious change is the automation of business processes and decisions. Automation in business processes concerns e.g. automated processing of contracts and automated reporting of claims. Decisions to be automated includes e.g. underwriting, claim settlement, and product offerings. In their study Eling and Lehmann referred to a global study conducted by Catlin et al. (2015), and they noted that approximately 70 per cent of insurance processes were manual, 25 per cent were partly automated, and 5 per cent were fully automated. In the future (the amount of years was not estimated) when digitalization is matured, the amount of manual work is estimated to be at 15 per cent, partly automated processes at 50 per cent and fully automated processes at 35 per cent. At this stage non-commission costs are expected to decrease 30-50 per cent (Eling & Lehmann 2018). Therefore, in spite of digitalization, most processes will require some amount of manual work.

The third major change caused by digitalization concerns product development. The old products are able to develop and for example in life/health and motor insurance telematics devices offer building of smaller and more accurate risk pools which allows the offering of cheaper prices. Digitalization changes the operating environment for insured as well and emergence of new products such as cyber risk insurance will be possible as well. Since digitalization changes business processes, some products that weren't feasible before, may now become possible for insurance companies to offer. (Eling & Lehmann 2018) One example of such product is disability insurance for HIV and diabetes patients offered by AllLife in South Africa. The insurance company has access to health data of the insured and is able to see if the person is following personalized advice on managing their conditions made by the doctor in monthly check ups. If these advices are not followed, the coverage can be reduced or cancelled. (Brat, Clark, Mehrotra, Stange & Boyer-Chammard, 2014)

Automation of business processes will likely increase productivity, lower personnel expenses and enable faster operations. Automation also reduces errors and quality variations compared to manual system in operations. This generally improves the quality of operations. (Ilmarinen & Koskela 2015, 24-27, 126) Digitalization leads businesses to change their operating models and customers to change their behavior and therefore digitalization has a strong affect to market dynamics (Ilmarinen & Koskela 2015, 17).

2.4.2 Blockchain in insurance context

Blockchain is increasingly attracting the attention of researchers and the insurance industry and is considered a breakthrough technology (Gatteschi et al. 2018). Blockchain seems to have some profound implications for the world that makes it categorized as foundational technology, like internet in the 1990s (Disparte 2017). Blockchain will be described more deeply in chapter 3.1, where its mechanism of action is broken down and its concept is explained. In this section we will look at the implications this technique has for the insurance industry from an academic point of view.

Recent developments in blockchain technology have heightened the need for research for implementing this technology in insurance companies. As a result, in 2016 five big insurance companies (Aegon, Allianz, Munich Re, Swiss RE and Zurich) established a new company B3i (The Blockchain Insurance Industry Initiative) for this purpose. B3i's objective is "*to explore the potential of using Distributed Ledger Technologies within the re/insurance industry for the benefit of all stakeholders in the value chain*" (B3i 2018).

Blockchain technology has many kinds of potential in insurance industry. Lorenz, Münstermann, Higginson, Olesen, Bohlken and Ricciardi (2016) see three ways in which blockchain technology can promote the growth of insurance companies: customer engagement, cost-effective insurance products for emerging markets, and integration of insurance products with IoT technology. In these areas, blockchain technology provides a distributed and trusted platform for customer data, peer-to-peer (P2P) insurance and smart contracts. Smart contracts offer a number of benefits: they allow automation of compensation; they serve as a reliable and transparent payment mechanism for the policyholder and they can be used to implement contract-specific rules. (Lorenz et al. 2016) According to Stockwell, Francis, and Krishnamurthy (2017) Blockchain Technology enables insurance companies to dramatically reduce their operating costs by automating data processing processes. In particular, the acceleration of the compensation process and the reduction in fraud were seen as the greatest benefits of introducing blockchain technology. In addition, some insurance companies may also have to reconsider the basic functions of their business. (Stockwell, Francis & Krishnamurthy 2017)

Meduri Pridhvi, Mehta, Joshi and Rane (2018) stated that Blockchain is able to disrupt the insurance industry. Disparte (2017) states in more detail that blockchain technology has the potential to make radical changes in the whole value chain of insurance by improving transparency in operations and outcomes. Gatteschi et al. (2018) state that for insurance industry blockchain is expected to bring value for improvement of customer experience and reduction of operating costs, data entry/identity verification, premium computation/risk assessment/frauds prevention, pay-per-use/micro-insurance, and peer-to-peer insurance.

Blockchain has the potential to reconcile some of the problems that currently plague the insurance industry. One of the key problems insurance industry has in modern days is the lack of trust. Trust in financial service sector is at all-time low (Disparte 2017). The core value of blockchain technology is to allow trust by replacing an arbitrator with a digital substitute and central authorities with algorithmic trust among distributed peer-to-peer networks. (Järvenpää & Teigland 2017) Therefore, blockchain is able to improve both trust and process fluency in insurance industry. In some cases, process fluency can reach a level where the entire process of a product is fully automated (Eling & Lehmann 2018). The objective of peer-to-peer insurance is to remove intermediaries—the insurance companies themselves. Therefore, this development represents a threat to established insurance companies. (Gatteschi et al. 2018)

Another challenge in insurance industry is the parts which create unnecessary friction, regulatory pressure, and agent problems. One source for these issues are the insurance brokers, which give independent advice on available insurance products and help their clients to purchase insurance. Insurance broker market is fairly concentrated: companies such as Aon, Marsh, and Willis Towers Watson have been dominating the markets by controlling $32 billion in global revenues. (Disparte 2017) Blockchain has presented as a solution to help to cut off this middleman out of the insurance distribution chain. (Mainelli & von Guten. 2014)

There are issues to be found from policyholders' point of view as well, where blockchain could provide a solution. One example of this is unapplied claim. It has been estimated that in U.S. there are unclaimed life insurance policies worth of $7.4 billion total because beneficiaries have been incapable or uninformed of their rights to seek redress. Blockchain technology could help with this issue as well by automated claim process. (Disparte 2017) A global insurance consortium Riskstream Collaborative has announced that their first blockchain use case for life insurance will be a system which automatically gets data from the public death records in USA (The Institutes 2019). If the process were to be fully automated so that as a person dies, the blockchain system will be notified and based on that trigger it would be able to pay the claim for the recipient of the compensation without the need to make a claim to the insurance company. This therefore might offer the solution for unpaid insurance claims.

2.5 Disruptive innovation in insurance industry

The concept of innovation and reflection on the importance of innovation originated to the domain of economics through the views of Joseph Schumpeter (Ray 2009). Innovation is often considered as a process, which extends from idea to value creation. Overall innovation has a positive undertone and it

reflects change for the better. (Siltala 2010, 57) Innovation is defined in Equation 1 by Ståhle, Sotarauta, and Pöyhönen (2004, 11).

New idea + execution + value creation = innovation

Equation 1 - Innovation equation (Ståhle, Sotarauta, and Pöyhönen 2004, 11)

New idea in innovation context traditionally means that individual or community sees the idea as new (Rogers 2003). Therefore, the idea itself can in fact be old, as long as the experience of novelty exists (Siltala 2010, 57). Additionally, for an idea to be an innovation, it needs not only to be new, but it needs to be executed in a way that crates some value. Therefore, we can only call an idea as innovation after it has created real value. The value created by innovation may not necessarily be an economic added value. There can also be value in improving the work environment, quality of life or learning outcomes, for example. Innovation does not necessarily lead to an improvement in the performance of an organization, although such an error in favor of innovation is common in the innovation literature (Kimberly, Renwhaw, Schwartz & Hillman 1990). Often, it is only the reception of the world outside the organization that determines whether the implemented idea is beneficial or detrimental to the success of the organization. (Ståhle, Sotarauta, and Pöyhönen 2004, 11-13)

2.5.1 Disruptive innovation

Innovation can be divided in several ways depending on the chosen point of view. Bower and Christensen (1997) divided innovation into two categories: sustaining innovation and disruptive innovation. The differentiator between these two innovation types is in how they meet the requirements of the current customers. (Bower and Christensen 1997) According to Christensen (2006, 49-50) disruptive innovation should not be economically attractive to the incumbent company in relation to other investment opportunities. Sustaining innovation instead is more often economically attractive for incumbent companies. Established companies tend to eschew radical innovations and favor more sustaining innovations (Teece 2007).

Sustaining innovation is more broadly used in business environment and it sustains the current markets by developing current products by reacting to changing customer requirements. These requirements usually come from the most demanding customers - also known as high-end customers. (Christensen 1997) Major benefit therefore goes for incumbent companies and demanding customers (Christensen & Raynor 2003, 32).

Disruptive innovation is a term coined by Clayton Christensen in 1995 to describe situation in which new entrants with fewer resources compared to incumbent firms successfully challenge those incumbent firms. (Christensen, Raynor & McDonald 2015) There are two ways for disruptive innovation to appear. Firstly, disruptive innovation can appear in a situation in which there are over-looked segments in the market. In this case the entrant is able to create a new and a better product for low-end customers and as it evolves, it is able to move up-market. In this case the markets products have potentially over performance the need of low-end customers. This can lead to willingness to change old the service provider into new cheaper one as it comes to exist. (Christensen & Raynor 2003, 43 - 49.) Secondly, disruptive innovation is able to appear when markets are created where there were no such markets before. As this new innovation evolves, it is able to attract customers from the original markets as well. (Hopp et al. 2018)

In the case of new market disruption, products, and services have become more affordable and easier to use, which allows the use of these products for new customer base. This can be called technical disruption. As technical disruption matures to meet mainstream customer needs, a market disruption is generated. (Yu & Hang 2010, 436-437) At this point mainstream customers change the old product to this new product created based on the disruptive innovation, which represents better performance in a new feature appreciated by customers. Christensen's classical example from hard drive market presents this situation. Hard drive customers used to appreciate large storage capacity that 5.25" hard drive was able to offer. Demand for storage capacity was satisfied with these products and even served over the needs of the era, and as a result, customers began to appreciate the physical size of hard drives. This requirement was met by a physically smaller 3.5" hard drive as a disruptive innovation. Its performance initially satisfied only the customers with the need for smaller storage capacities, but as a result of technological advances, storage capacity increased to a high degree and also met the requirements of mainstream customers. However, the hard disk storage capacity was still lower compared to the 5.25" hard drive, but customers no longer appreciated additional capacity. As a result, manufacturers switched to 3.5" hard disk drives. (Christensen 1997, s. 184 - 187.)

When disruptive innovation evolves to serve needs of mainstream customers, it also starts disrupting incumbents (Schmidt & Druehl 2008, 347). This disruption may come unexpectedly since disruptive innovation first underperforms the mainstream customer needs and therefore it does not appeal for mainstream markets. (Govindarajan, Kopalle & Danneels 2011).

By initial definition in the beginning disruptive innovation only serves the needs of low-end customers, whom has been forgotten by incumbent companies often due to focusing high-end customers' needs (Christensen et. al. 2015). Govindarajan & Kopalle (2006) suggested that disruptive innovation should include disruption ensue by high-end entrants as well. In 2015 Christensen refined the concept of

disruptive innovation to match this suggestion. Christensen justified this by the example of uber, which came to the market through high end customers. However, uber had a very different business model than traditional taxis as they don't have fixed prices and they don't own the cars. This example showed that the causal mechanism of disruptive innovation is not being at the bottom of the market but it's a business model that is unattractive to the competitors. (Forbes 2016)

It is necessary to present some misunderstandings about disruptive innovation as it helps to better understand the concept. Abbosh, Savic & Moore (2018) suggest that there are some misconceptions regarding disruption at industry level. First and one of the biggest misconceptions is that disruption is random, mysterious and unpredictable. Second misconception is that disruption happens without control of objective parties. However, Accenture's research has found that industry disruption is reasonably predictable, and it is possible to predict disruption by industry. (Abbosh, Savic & Moore 2018) Thirdly disruptive innovation is not always the result of new companies entering the market and does not always lead to the replacement of incumbent companies and existing businesses. Disruptive innovation can be caused by current domineering company and it is possible that incumbent companies survive by serving high-end customers better. (Yu & Hang 2010, 439) Thus the concept of disruption exists irrespective of the outcome (Christensen 2006, 41)

In scientific research the term disruptive innovation occurs frequently in connection with new business model (Hopp et al. 2018). According to Mitchell and Coles (2004, 18), business model innovation has succeeded when a change in any element of the business model results in improved performance or benefit. Successfully implementing business model innovation is challenging, but as it happens it is particularly successful way to innovate and results are often good (Schallmo & Brecht 2010).

Chesbrough (2010) notes that experimenting of operations is particularly important in generating business model innovations and removing barriers, as practical measures help to build new knowledge. Testing with the right customers is important because it gives you the most realistic picture of the business model. Chesbrough (2010) emphasizes that experimenting helps to ensure the full functionality of a new business model. (Chesbrough 2010) A business model innovation should therefore be an iterative process that creates gradual improvements to the business model and possibly completely new innovations and business models. (Garcia & Calantone 2002, 124)

2.5.2 Disruption in insurance industry

Change in business is inevitable. In 1999 Fine argued that an industry clockspeed can be found in every industry, and it describes the velocity of change (Fine 1999). Insurance industry has traditionally been slow to change, but now recent developments imply change in that speed (Cortis, Debattista, Debono &

Farrell 2018, 72). Current insurance companies are threatened by giant firms such as Amazon as it is entering the market (Seekings 2017) but also by small and agile start-ups, that are leveraging the power of technology (Cortis et al. 2018, 72). These starts-ups leverage new technology such as big data paradigm, artificial intelligence techniques and blockchain or distributed ledger technology (DLT) (Cortis et al 2018, 72). Utilization of these technologies is often called "InsurTech" (Cortis et al. 2018, 72). The term is inspired by the example of more established concept "FinTech" which is a term used in financial sector for technology that seeks to improve and automate the delivery and use of financial services (Investopedia 2019c). Sometimes (see e.g. Eling & Lehmann 2018) this term has also been found to describe a start-up that works in insurance field utilizing these new technologies.

At times the change in an industry is so significant that it can be called disruptive[9]. Eling and Lehmann (2018) have argued that the disruption in insurance markets is unlikely to come from InsurTech start-ups. They have four arguments to support their statement: (1) established companies are able to copy InsurTechs' business models, (2) established companies have the possibility to acquire InsurTechs, (3) InsurTechs are more focused to cooperate rather than rivalry with insurance companies and (4) the strong entry barriers caused by the regulation and unsolved legal questions. (Eling & Lehmann 2018)

Disruption in industry level is not unpredictable but can be predicted. Accenture has conducted a research for 3600+ companies in 80 countries in 2018. Based on that information a Disruptability Index was created (Figure 3), which shows the level of current disruption and how likely the industry will become disrupted in the future. Accenture states that disruption is inevitable, but its impact differs by industry. The level of current disruption in industry on scale 0-1 the median was 0,51 and the score for insurance industry was 0,35. This was the second lowest result in the study just after health industry. The insurance industry does not therefore seem to be subject to strong disruption at 2018 compared to other industries in general. The research also measures susceptibility of future disruption. On scale 0-1 the median was 0,57 and the score for insurance industry was 0,68. Therefore the disruption seems to be clearly stronger in the future for insurance industry than in the industries in general. (Abbosh, Savic and Moore 2018)

[9] In Cambridge English Dictionary disruption is defined as an interruption in the usual way that a system, process, or event works. (Cambridge English Dictionary 2019)

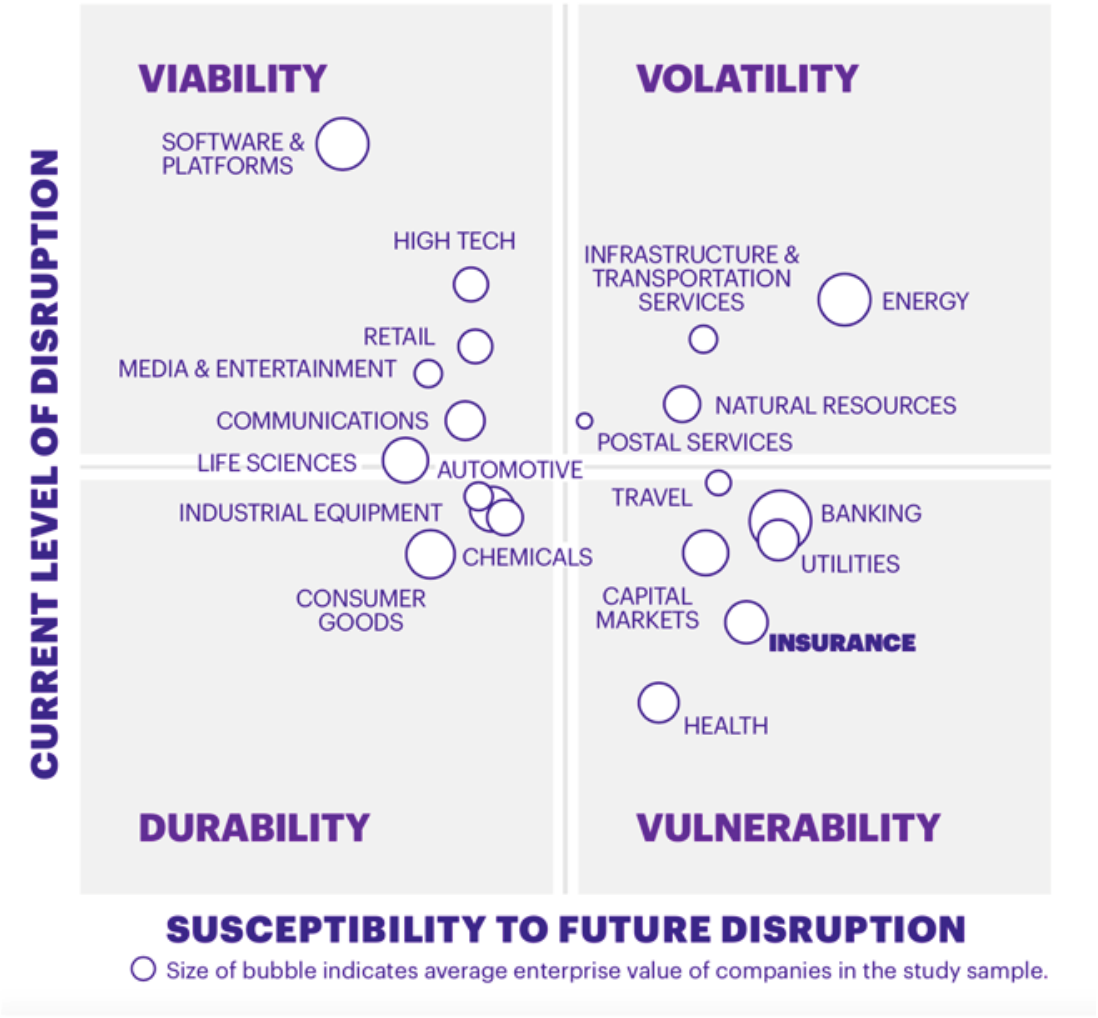

Figure 3 - Accenture's disruptability index
(Abbosh, Savic and Moore 2018)

Accenture's disruptability index categorizes 20 industry sectors and 98 subsectors in to four categories based on current level of disruption and susceptibility of future disruption (see Figure 3). These four categories are viability, volatility, durability and vulnerability. Industries like insurance which are low on current level of disruption and high level of susceptibility of future disruption belong to the category of vulnerability. Industries in this category benefit from the high entry barriers due to regulation and capital requirements. The research also states that industries in this category often face increasing pressure for efficiency, and this pressure attracts new entrants and industry disruption. (Abbosh, Savic and Moore 2018)

Disruptors tend to be successful in three way: They are able to lower prices dramatically, create and deliver significant innovation and breaking down incumbent's entry-barriers and defenses. (Abbosh, Savic and Moore 2018) It can be inferred from this that the insurance industry, which has been protected for a long time by strong entry-barriers, is not protected from future disruption.

3 DECENTRALIZED AUTONOMOUS ORGANIZATION

Decentralized autonomous organization (DAO) is a blockchain based organization innovation (Dupont 2017). This chapter will elaborate the basic idea of DAO through the underlying technologies, previous research and one existing use case. These aspects combined are used to form a definition of DAO in chapter 3.5 for further use in this research.

3.1 Enabling decentralization and trust through blockchain technology

Blockchain technology was introduced in 2008 by Satoshi Nakamoto in his paper "Bitcoin: A Peer-to-Peer Electronic Cash System". In this paper Nakamoto raised up the issue of the need for trusted third parties[10] when utilizing digital currency — particularly in avoiding double spent. In order to create a peer-to-peer electronic cash system that would have no need for the trusted third party, Nakamoto introduced network where trust is guaranteed by tree elements: hash, consensus mechanisms and decentralization. (Nakamoto 2008)

The name of the blockchain comes from the structure of the technology. Information is divided into separated blocks, which are linked together, hence it is called blockchain (Crosby, Nachiappan, Pattanayak, Verma & Kalyanaraman 2016, 10). Each block contains a unique signature or name that is called hash[11]. Hash is created for each block as a part of process of creating a new block. In practice hash is a unique set of numbers and letters. Each block contains not only their own hash, but the hash of the previous block as well and therefore every block point to a previous block and hence create a chain. (Nakamoto 2008, 2) The only exception is the very first block—also called as a genesis block—that only holds its own hash (Beck, Stenum, Czepluch, Lollike & Malone 2016). Hash is mathematically created based on the content of the block (Nakamoto 2008, 2). Therefore, if something is changed in the block, the hash of that block changes. Because the next block includes the hash of the previous one, these hashes can be compared, and the change would be noticed (Chang 2017). This helps to make sure that as data is set on the blockchain, it can't be removed or changed.

As mentioned above, the second element to assure trust in Bitcoin's blockchain is a consensus mechanism, which is a mechanism to reach consensus between the network parties on what information

[10] Established, reputed, and responsible fiduciary entity accepted by all parties to an agreement, deal, or transaction as a disinterested and impartial intermediary for settlement of payments and post-deal problems. (Business Dictionary 2019)

[11] A hash is a function that converts an input of letters and numbers into an encrypted output of a fixed length. A hash is created using an algorithm and is essential to blockchain management in cryptocurrency. (Investopedia 2019b)

is accepted and added to the chain (Nakamoto 2008). Consensus is a fundamental and difficult issue to solve in order to have fault tolerant distributed computing (Rütti, Milosevic, Schiper 2010). Bitcoin has solved this issue by using consensus mechanism called *Proof-of-Work,* in which all nodes (also known as "miners") compete with each other to be the one to generate a new block. Before a block is generated, the generating node needs to prove that it has given enough computing power to solve a complex mathematical problem. In Bitcoin the complexity of the problem is set to a level where it takes on average 10 minutes to solve this problem. After the solution is solved, rest of the network will agree on it and the new block is created to the chain. Miners are financially rewarded on their efforts with small amounts of Bitcoin released by the system each time a block is created. (Crosby et al. 2016, 11-12)

The third aspect of the trust in blockchain comes from decentralization. This means that the system is not operated by one party, but many, which leads to absence of single point failure caused by one centralized operator. In Bitcoin each node collects all transactions made in the network and works to solve the mathematical problem to get the proof-of-work. The first node to solve the problem broadcasts the block to other nodes. All the nodes in the network will then accept the block if the content is valid and there is no double spending. (Nakamoto 2008, 3) In a decentralized arrangement securing transactions is decentralized to several different actors. Thus, the stoppage or departure of one or more operators does not affect the operation of the system. (Xu, Weber, Staples, Zhu, Bosch, Bass, Pautasso, Rimba 2017, 3) Participants can be completely unknown to each other and trust is created by game theoretical incentives. The parties maintain the integrity of the blockchain by ensuring the current status with common consensus. (Mattila 2016, 7)

Not all blockchains operate in decentralized manner and therefore it is important to recognize different ways to create a blockchain system. In unpublished paper presented in 2017 IEEE 6th International Congress on Big Data, Zheng, Xie1, Dai, Chen, and Wang divided blockchains into public -, consortium – and private blockchains (see Table 3 - Comparisons among public blockchain, consortium blockchain and *private blockchain*.). According to them private blockchain is considered as centralized system, and therefore it is not eligible to be used in DAO. Consortium blockchain is considered to be partially centralized and its eligibility for the use of DAO needs further research. For these reasons private blockchain and consortium blockchain are not addressed in this study.

Table 3 - Comparisons among public blockchain, consortium blockchain and private blockchain. (Zheng, Xie, Dai, Chen and Wang 2017)

Property	***Public blockchain***	***Consortium blockchain***	***Private blockchain***
Consensus determination	All miners	Selected set of nodes	One organization
Read permission	Public	Could be public or restricted	Could be public or restricted
Immutability	Nearly impossible to tamper	Could be tampered	Could be tampered
Efficiency	Low	High	High
Centralized	No	Partial	Yes
Consensus process	Permissionless	Permissioned	Permissioned

Bitcoin represents an example of public blockchain. This means that consensus is achieved with the involvement of all miner nodes and that all data in the chain is available for anyone to read. Public blockchains are considered as permissionless, which means that anyone can join and run a node. These nodes do not have to know each other and in spite of the system can be trusted and is considered nearly impossible to tamper with[12]. Efficiency in public blockchains is considered to be low and as discussed earlier they are not centralized. (Zheng, Xie, Dai, Chen and Wang 2017)

To summarize the benefits for blockchain technology: it enables the use of decentralized systems, which eliminate the single point of failure caused by one centralized operator. The key feature of blockchain is that it assumes that nodes behave arbitrarily (or byzantine) and being able to tolerate byzantine failure[13] by design, blockchain offers stronger security than well-established database systems (Dinh, Liu, Zhang, Chen, Ooi & Wang 2018; Mattila 2016, 7).

3.2 Enabling automation through smart contracts

Smart contract is a concept for bringing automation and hence a level of autonomy into blockchain. Autonomy can be defined as a state where one is able to make significant decisions without the consent of others (Brock 2003). Nick Szabo introduced the concept of a smart contract in 1994. He defined it as "a computerized transaction protocol that executes the terms of a contract" (Szabo 1994). He suggested that some clauses of the contract could be written into the code that can self-enforce them. This

[12] Despite the nodes not knowing each other the system can be trusted and is considered nearly impossible to tamper with

[13] Byzantine failure gets its name from byzantine generals' problem. It states that reliable computing system needs to be able to handle situations when conflicting information is given from malfunctioning components to different parts of the system. (Lamport, Shostak, & Pease 1982)

procedure would reduce the need for trust between parties and occurrence of vicious and accidental exceptions. (Christidis 2016) In practice smart contracts are simple computing programs.

Although the agreements were already introduced in the 90s, it was not before blockchain—especially Ethereum blockchain—that the full potential of smart contracts was revealed. Ethereum is a newer cryptocurrency and a prominent Turing-complete[14] smart contract platform (Ethereum Foundation 2014). Both Bitcoin and Ethereum support smart contracts, but Ethereum supports smart contracts that allow value to be used in multiple invocations. Therefore, it has become more used platform for smart contracts than bitcoin. (Luu, Chu, Olickel, Saxena & Hobor 2016) Ethereum uses its own programming language called Solidity (Ethereum Foundation 2014), which hold in some unsafe design choices as the example of The DAO showed. This example of The DAO will be deeply discussed in chapter 3.4. Since this accident a number of other vulnerabilities related to smart contracts has been reported (Buterin 2016; Atzei, Bartoletti, Cimoli 2016; Luu et al. 2016)

Smart contract technology has some use cases in insurance industry already. For example, in the autumn of 2017, the large French insurance company AXA released its own blockchain-based insurance as the first major insurance group in the world. It's blockchain-based product Fizzy is 100% automated smart contract-based flight delay insurance. The main idea is that if the flight is delayed by more than two hours, the contract will automatically and immediately compensate the agreed amount. All delays are compensated, no matter the reason for the flight delay. (AXA 2017) This protocol therefore has automated the claim handling process.

Another company who utilizes smart contracts is Etherisc, that launched their own flight insurance soon after AXA did in autumn of 2017. Etherisc is currently developing smart contract-based insurances for hurricane protection and crop insurance. Etherisc plans to utilize blockchain based solution as well in crypto wallet insurance, collateral protection for crypto-backed loans and social insurance. Their value promise for customers is to give a better price and faster payments than regular insurers. (Etherisc 2019) As Etherisc's example shows, smart contracts could have multiple use cases in the insurance market.

3.3 Example of DAO: Augur

At the time of writing this thesis, there is no insurance DAO that would be mature enough to be presented here as an example of a DAO. However, seeking coverage for future events can also be made outside of insurance markets. Therefore, I will use an example that holds similarities of what a potential insurance

[14] Machine is called Turing-complete when it is able to solve any king of computational problem, no matter how complex when it has given enough of memory, time and instructions (Binance academy 2019).

DAOs could look like. One place to seek coverage for future events besides insurances are prediction markets. One example of DAOs is a prediction market protocol Augur. Earlier in this study we used Etherisc and AXA's Fizzy as an example of project that utilize smart contracts. However, these projects are not considered as DAO's, since the governance is held by a single entity. Furthermore, we use Augur as an example, because it has been able to develop a working on the market protocol and it is possible to some extend to find conformities between prediction markets and insurance markets. These conformities may be found from market's lifecycle and from the protocol that decides the outcome in an event that cannot be coded and automated straight into smart contract like Fizzy (see chapter 3.2) has done.

Augur was built with crowdfunding assets worth of 5,3 Million USD on October 2015 (Attachment 1) and launched in July 2018. On 16th of February 2020 there was 2800 ETH in Augurs balance (Attachment 2). At the same date ETH was worth of 248,36 USD (Attachment 3), which means that there was around 700 000 USD being held in Augurs smart contracts. The amount is significant in proportion to number of users. On 16th of February 2020 Augur had 19 users during last 24 hours (Attachment 1). Augur therefore is not a popularized platform but is trusted enough to hold significant amount of assets in its smart contracts.

Prediction markets are collection of people speculating future events (Investopedia 2019a). In order for market creation, there needs to be one or more parties for both sides of the contract. Market creation in Augur is available and possible for everyone with the access to internet. The duration of the prediction market can differ from insurance, but the life cycle of the prediction market is somewhat similar to insurance: (1) the market/product is created, (2) the asset can be traded in secondary markets before the market event happens, (3) the event specified in the contract occurs, (4) event will be reported and (5) settlement will be agreed. This outline is pictured in Figure 4. (Peterson, Krug, Zoltu, Williams & Alexander 2018)

Figure 4 - Simplified outline of the lifetime of a prediction market (Peterson et al. 2018)

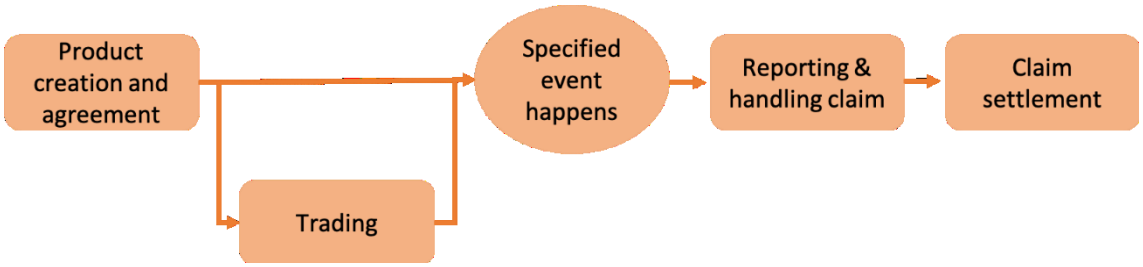

Figure 5 - Simplified outline of the lifetime of an insurance market

Insurance market's lifetime can be seen similar to prediction market, and it is pictured in Figure 5. In the first phase production is created and agreement has been reached between parties. In the second phase it is possible for insurance company to trade the insurance risk e.g. in reinsurance markets. Third phase contain occurrence of specific event. In fourth phase claim must be reported and processed. And in the fifth and final phase settlement takes its place.

The first step is open for anyone who wishes to make a market in Augur and the prediction can be about any upcoming event. The creator defines *the event end time* and chooses *a designated reporter*, who will do the first but not the final reporting of the event in question (see Figure 6). The creator also defines *a resolution source* that should be used by designated reporter when reporting the outcome. The resolution source can simply be "common knowledge" or specified entity e.g. "The United States Department of Energy". After market has been created, the trading begins. As a first action parties willing to participate pay their shares to the Augur's smart contract. Then Augur creates shares and sends them to participants, which then can be traded freely. (Peterson et al. 2018)

After the market event happens, the reporting process that is pictured in Figure 6 starts. In the first phase (Figure 6a) the designated reporter reports the market outcome to Augur. If the designated reporter does not do this in 3 days, the reporting opportunity opens to all reporters in the system (Figure 6b). Reporters have financial incentive to participate into reporting as the system rewards for activity and proper functioning and punishes for passivity and malfunction. (Peterson et al. 2018)

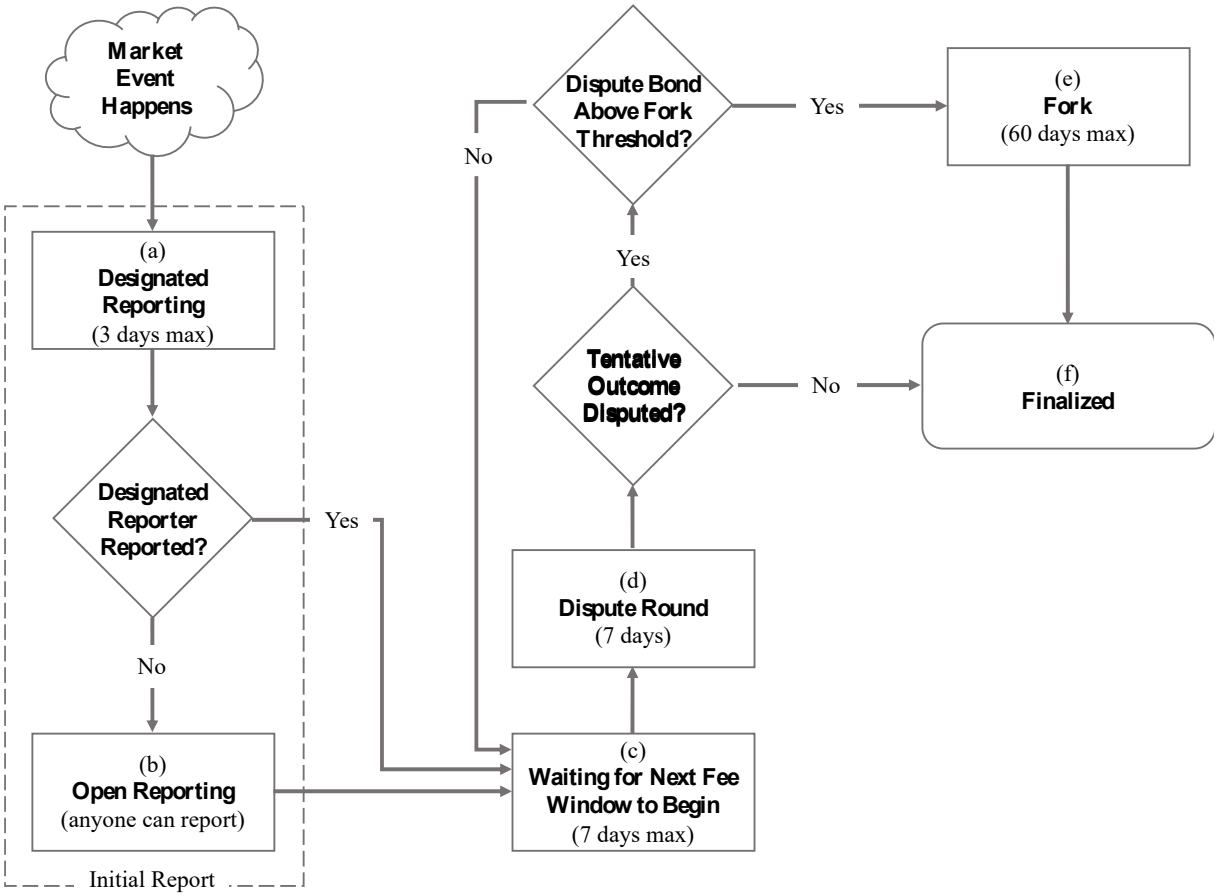

Figure 6 - Reporting flowchart of Augur
(Peterson et al. 2018)

After initial report phase the market enters to waiting for next fee window to begin phase (Figure 6c). During this phase reporting for the market is on hold. When the phase ends, the market goes into 7-day period (Figure 6d) in which all other reporters may dispute the initial outcome. If dispute will not occur, the initially reported outcome will be the final outcome. In case of successful dispute, the market will either undergo another dispute round, or it will enter the fork state. If the dispute is considered not to be prominent (staked REP[15] is under 2,5% of all REP), the market undergoes another dispute round. This time the outcome will be the market's new tentative outcome. In case when dispute is considered to be prominent (staked REP is over 2,5% of all REP) the market goes to fork state (Figure 6e). (Peterson et al. 2018)

The fork is a special state that is designed to be a rare occurrence. When some market enters to fork, all the other non-finalized markets in dispute round go into hold until the fork period is over. Fork period is fairly long, since participants needs to have ample time to prepare. In fork Augur will create *child universes* for different outcomes. Participants vote on the correct outcome of the market and the universe

[15] Reputation (REP) is a cryptocurrency, used by reporters during market dispute phases of Augur. (see more: https://www.augur.net/faq/#what-is-reputation) (Augur 2019)

with most votes will win. After fork Augur will reward participants who voted the winning outcome and penalize those who voted alternatives. The outcome of the fork will be the final one and cannot be disputed. When enters to finalized state, the reporting process is over. The final phase in the lifetime of Augur's prediction market is settlement, in which the participant whose prediction was correct can collect their assets. (Peterson et al. 2018)

Augur has been able to develop DAO protocol that starts from the creation of the market and goes all the way to the settlement phase. It is worth to notice that Augur has developed a reporting mechanism for handling unclear situations, and it has survived on the market. This feature is vital for insurance markets as well. The example of Augur supports the idea that DAO could be functioning organizational structure. However, it is still too early to make this conclusion.

3.4 Decentralized autonomous organization in scientific discussion

Decentralized autonomous organization represents innovation in organization structure that utilizes computerized rules and contracts (Chohan 2017g; Dilger 1997; Dupont 2017; Jentzsch 2016; Norta, Othman & Taveter 2015; Norta 2016; Swan 2017). The concept is to program the rules and decision-making apparatus of an organization into code and hence eliminate the need for government roles (Mehar et al. 2019). According to a report by the research institute of the Finnish economy a multi-smart contract network can form an entity that organizes the similar or the same functions as the most traditional forms of organization (Lauslahti, Mattila, Seppälä 2017). In practice DAOs are complex set of smart contracts which are used to encode rules to govern an organization e.g. how decisions are made and what's the weight of each members vote (Gatteschi et al. 2018)

Decentralized autonomous organization (DAO) -term was first introduced by Vitalic Buterin, a founder of Ethereum Foundation, to describe a pseudo-legal organization run by an assemblage of "robot" and human participants. The robots are meant to be coded mechanisms that react to certain inputs. The inputs can contain autonomous sensors, (e.g., a digital thermometer), online inputs (e.g., a change in stock price), or human made reports. (Dupont 2017)

One of the most known DAO projects is The DAO and it has been researched in the academia as well. The core idea was to build an organization without the oversight of managers (Mehar et al. 2019). The DAO had an intent to serve as a platform for investors to invest directly in certain kind of blockchain projects (Dupont 2017). One of the founders Christoph Jentzsch (2016), described The DAO as an organization in which (1) participants maintain direct and real-time control over organization, and (2) administrative rules are formalized, automated, and implemented with software (Jentzsch 2016). The DAO was crowdfunded with USD 150 million worth of ETH during 28-day funding period in April

2016 (Lauslahti, Mattila, Seppälä 2017, 5). In June 2016 The DAO was hacked and tens of millions of dollars were stolen from the system (Lauslahti, Mattila, Seppälä 2017, 5).

There are some descriptions in practitioner literature which aim to describe what happened to The DAO (e.g. Siegel, 2016; Hertig, 2016; del Castillo, 2016). In addition to that in 2019 Mehar et al. presented a novel academic case study of The DAO Attack. They declared that The DAO was inspired by theories from Economics and Organizational Studies. These include contract agency cost (Ross, 1973; Eisenhardt, 1989), contract theory (Gale & Hedwig, 1995; Bolton and Dewatripont, 2005), auction mechanisms (Edelman, Ostravsky, and Schwartz, 2007; Roth, 2002), theories of innovation (Greenstein, 2015; Moeen & Aggarwal, 2017), and virtual organizations (Handy, 1995; Markus & Agres, 2000). (Mehar et al. 2019)

Mehar et al. (2019) stated that the organizational structure of DAO offers many advantages. It eliminates the need for governmental directors in organization and hence the costs deriving from them as well. Mattila (2016) shapes the same idea so that in DAO's structure human work is moved from the center to outskirts and is organized algorithmically (Mattila 2016). Another advantage of DAO is that it also ensures that once decisions have been made, no one can tamper with them since they are written in a permanent code. However, they also note that if implementation is done too quickly these advantages may turn detrimental and it can also increase the likelihood of flaws in code. (Mehar et al. 2019) DAO's structure and functions have also raised issues on governance (Chohan 2017a, 2017b, 2017c, 2017d, 2017e, 2017f; Dupont 2017) and legal framework (Wright 2015).

In their paper Mehar et al. (2019) used insurance as an example to illustrate the functionality of smart contracts in real life scenario. They also mention that there is prototype in development stage that is to be released soon. This supports the idea that insurance DAO could exist at some point. In addition to Mehar et al. research, Shermin Voshmgir (2017) has argued that blockchain and smart contracts have potential to disrupt the traditional governance structures by reducing bureaucracy through decreased transaction costs, solving the principal – agent dilemma and the moral hazard associated with it. (Shermin 2017) The principal-agent dilemma occurs when the agent is empowered to make decisions on behalf of the principal. The agent is expected to be a self-interested utility maximizer who will seek her own interests over the principal's. Moral hazard occurs e.g. when the agent takes more risk because someone else will bear the risk. (Eisenhardt 1989)

3.5 Definition of DAO – Decentralized Autonomous Organization

In this thesis Decentralized Autonomous Organization is defined as a transparent[16] organization that is managed and owned in a decentralized manner and where administrative rules are formalized, automated, and implemented with software that utilizes blockchain technology and smart contracts. Figure 7 illustrates this definition through Venn diagram.

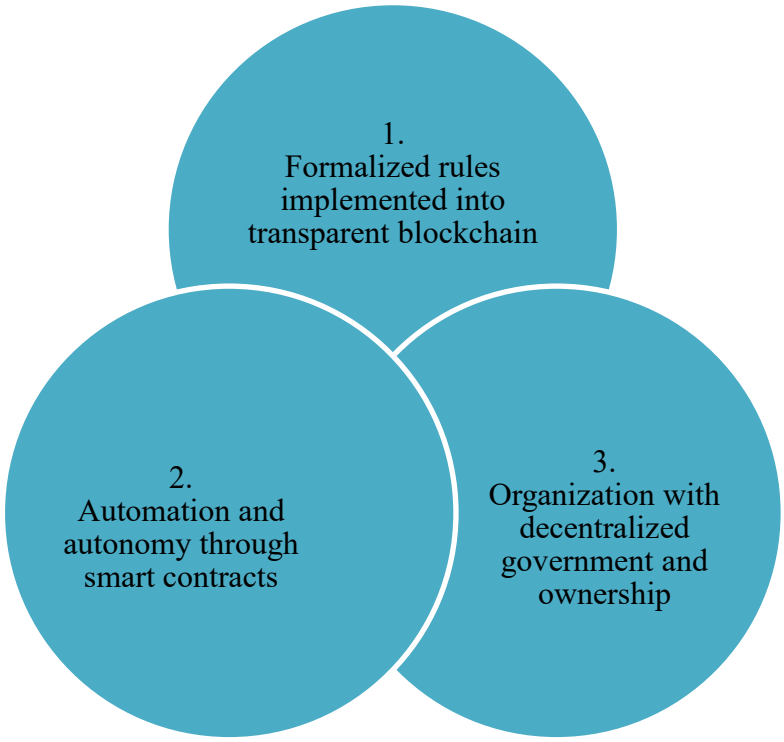

Figure 7 - Venn diagram illustrating DAO's key building blocks

DAO is a blockchain based innovation (Dupont 2017), and therefore blockchain technology is a natural component in the tripartite definition. As mentioned in chapter 3.1 there are different kinds of blockchains. In public blockchains data is available for everyone (Crosby et al. 2016). Public blockchains therefore satisfy the condition of transparency and hence the set condition for DAO. Private blockchains and consortium blockchains differ from public blockchains in many ways as discussed in chapter 3.1. One of the most interesting difference concerns decentralization of the system; private blockchains are considered as centralized systems and therefore are not eligible to use in implementation of a DAO. As for consortium blockchains it remains unclear if they satisfy the condition of decentralization and transparency. The answer may be dependent on how specific blockchain is built and therefore it is not possible to declare their fitting to DAOs like in case of public blockchains.

[16] By the definition of transparency, it is meant that the coded governance rules and made decisions are available for anyone.

The second part of Venn-diagram and the definition of DAO is that DAO's code needs to utilize smart contract and thus achieve a level of autonomy. Smart contracts—and only smart contracts in blockchain environment—enable automation and autonomy in DAO. As presented in chapter 3.2 utilization of smart contracts allows certain operations to be automatically enforced in specified conditions. In other words, the code is therefore able to self-execute a predetermined action based on given inputs. These operations are therefore not depended on a trusted enforcer; hence a level of autonomy is achieved. DAO's are built utilizing smart contracts (see 4.3), and therefore it must be included in the definition of DAO.

The third part of the definition is likely to be the most foundational for the definition of DAO. Decentralized autonomous organization can be seen as an organization innovation, which includes new way of forming organization (Chohan 2017g; Dilger 1997; Dupont 2017; Jentzsch 2016; Norta, Othman & Taveter 2015; Norta 2016; Swan 2017). As described in the name, DAO is decentralized organization. Decentralization in DAO in this research is set to mean that the governance and ownership is decentralized to. This is to ensure that all the power used in the organization is decentralized.

4 METHODOLOGY

Research should always have a purpose. This purpose can be either mapping, descriptive, explorative or predictive. (Hirsjärvi, Remes, Sajavaara 2008, 133-134) This research is explorative in nature and will elaborate the disruptive potential of new innovation DAO in insurance industry. Qualitative method is chosen to best serve the objectives of this research as due to novelty of the subject. In qualitative research it is possible to start with a clean table without any premise or definitions (Eskola & Suoranta 1998, 19). In this thesis DAO is encountered through the following presumptions: DAO is an innovation that has: (1) formalized rules implemented into transparent blockchain, (2) automation and autonomy through smart contracts and (3) decentralized government and ownership (see Chapter 3.5).

4.1 Interview structure

In qualitative research people are often used as informants and so does this research. Informants of this research create a whole with deep industrial and blockchain knowledge. Deeper description of informants is provided in chapter 4.2. According to Eskola & Suoranta 1998 (62), data collection should continue until new collections no longer provide new information for the research problem. In this research, 17 informants were enough to reach this point.

For successful research it is vital not to miss any central element on selected interview questions. More focus should be targeted into quality of the questions and not the quantity of the questions. (Jyrinki 1976, 41-42) The five selected interview questions were formed in order to answer to the research questions. The first interview question creates a link between theory and empirical findings. As DAO represents a new way of forming an organization, it is helpful to understand how this change compares to the traditional model of organizing insurance company. This change is elaborate through the change's informants recognize for the insurance value chain. As value chain model presents how an organization will create value for its customers, it forms a model for all of the central function's insurance company may have. Therefore, it is used in this research to categorize potential changes DAO could have.

The second and third questions aim to form an understanding of the overall potential of DAO in insurance markets. Therefore, the first three questions will form an understanding of DAO and its potential in insurance markets. The fourth question directs informants to examine if the potential described can be disruptive in insurance industry or not. Lastly, the fifth question seeks to unravel the main challenges for DAO adoption and hence to find barriers for the potential. This fifth question is

needed, as it may affect to the disruptive potential of DAO if such barriers could be identified which would preclude DAO adoption. The list of interview questions can be found from attachment 4.

The semi-structured interview method allows researcher to make clarification of the topic of discussion and each question. (Hirsjärvi & Hurme 2011, 106-107) This method was selected especially due to novelty of the topic as some clarifications during the interview would be needed if the interview would go more into non-relevant areas. The advantage of the method was that the interview proceeded from the central themes rather than the detailed questions. As a result, the meanings and interpretations given by the interviewees were central and emerged interactively. (Hirsjärvi & Hurme 2011, 47-48)

4.2 Description of interviews and experts

The key to the success of the research is to identify the expertise relevant to the topic and to select the key experts (Hyvärinen, Nikander, Ruusuvuori & Aho 2017). For this research 17 experts were interviewed (see **Error! Reference source not found.**). The requirements for informants were to have understanding on both insurance and blockchain technology, and a deep understanding form at least one of these areas. In order to have a deep understanding from insurance one had to have at least 20 years of work experience with insurance industry or possess a Doctoral Degree on insurance or work at a C-level position at an insurance company. In order to have deep understanding from blockchain one must have worked at least 3 years with blockchain technology. The low number of years required from blockchain technology derive from the novelty of the technology itself. There were three exceptions from these requirements made. All of these exceptions present the regulatory expertise. One of them had an extensive understanding on smart contracts in a legal frame, and she was recommended to be part of this study by one of the industry experts. Two other ones did not meet the criteria either but are currently leading the regulation work regarding InsurTechs (insurance technology firm) in Finland but also on EU level. As regulators can either prohibit or restrict operators in insurance markets, the inclusion of regulators perspective is seen desirable. One of the informants acted also as an advisor for this study. This informant was included due to extensive knowledge of the subject.

The preferred way to conduct the interview was a face to face meeting with the informant. This goal was successful in most of the interviews (14 out of 17 interviews). Due to logistical and scheduling reasons, 3 interviews were made in telephone. All interviews except one were made as one-on-one conversation (two regulator experts were interviewed together). 16 interviews were recorded; one interview was left unrecorded due to the interviewee's request as sensitive information from the InsurTech’s business was given. From this interview the extensive notes were taken. For every interview, one hour was initially allocated, but seven interviews took over one and half hours, due to

compelling discussions. All interviews were conducted in Finnish, and therefore all the citations have been translated into English by the researcher.

First interview was conducted without giving informant any specific foreknowledge excluding the theme of the research. Based on the experiences of that interview the DAO concept was challenging to address without pre-material, and therefore, the interview method was changed, and all the rest of the informants got to see the interview questions beforehand as well as some background material on the subject. The background material contained two articles on what the innovation in question is about (see Attachment 5) and the Nexus Mutual's white paper (see Karp & Melbardis 2018) was given as an example of insurance DAO. Nexus Mutual was selected due to its relevance. They have an ongoing insurance DAO project, and the team has relevant expertise. The researcher had an informal discussion with the CEO Hugh Karp in order to understand the business logic more thoroughly and to validate its relevance for pre-material purposes. Pre-material was voluntary to read, but most of the informants read the material.

All interviews were implemented in a quiet place, where only interviewer and informant(s) were present. All questions were asked from each informant but in few cases some of them were bypassed if informant made justification on why she/he is not a right person to answer certain question. In this research informants are anonymized and categorized as industry experts (8), Technical experts (6) or legal experts (3). From all interviews over 22 hours of material were recorded.

Table 4 - List of informants

PSEUDONYMN	DESCRIPTION	DATE	INTERVIEW LENGTH
Industry expert 1	Expert is an Insurance Executive with over 20 years of experience in P&C Insurance business. Expert was a co-founder, man behind the idea and CEO in Greenfield operation in Finland, where new purely digital P&C Company launched in 2012.	18.6.2019	40min
Industry expert 2	Expert is specialized in digitalizing insurance. The expert has over 20 years of managemental experience in Insurance sector. The expert is a founder of a peer-to-peer based insurance platform in Finland and has been working as a CEO in multiple insurance companies.	2.7.2019	1h
Industry expert 3	Expert works as a researcher in university and has his PhD in Insurance Science. Expert's research topics are related to mutual insurance companies and customer ownership.	6.8.2019	2h
Industry expert 4	Expert is an entrepreneur, founder of multiple companies and a CEO of blockchain based peer-to-peer company. The expert is exploring new ways to organize personal risk management.	14.8.2019	2h
Industry expert 5	Expert is a Liability Risk Management specialist at Nordic level insurance company. The expert has over 30 years of experience from insurance industry and deep understanding on blockchain technology.	14.8.2019	2h
Industry expert 6	Expert is a Chief Development Officer in Finnish insurance company and has nearly 30 years of experience form the insurance industry. Expert's specialization areas are possibilities given by technology to business opportunities and developing insurance and financial products.	15.8.2019	1h
Industry expert 7	Expert is a Chief Digital Officer at one of the top insurance companies in Finland.	20.8.2019	1,5h
Industry expert 8	Expert is a Consulting Domain Leader in Insurance at one of the largest IT firms in Nordics. The expert also has a MIT Sloan Executive Education certificate on Blockchain technology: Business Innovation and Application.	27.8.2019	2h
Technical expert 1	Expert works as a Head of Capital Markets and as a Blockchain Lead at one of the leading multinational technology consulting companies. The expert has 20+ years of experience from the financial sector and has a deep understanding on IT and business model development.	14.6.2019	20min
Technical expert 2	Expert is a researcher at the research Institute of the Finnish Economy and a doctoral candidate at university. Expert has been studying blockchain technology full time for over five years. The expert has been an advisor for various bureaus and ministries on blockchain-related policy issues on national and EU level and consulted for hundreds of companies on blockchain related strategy implications.	2.7.2019	1h
Technical expert 3	Dr. (tech) and an expert in business model innovation and design management. His research topics are related to business models and governance models of decentralized business ecosystems. Prior to expert's academic career at university he has nearly 20 years of experience as a designer and a programmer.	8.7.2019	2h
Technical expert 4	Expert is a researcher PhD candidate at university and a founder of a blockchain consulting company. Expert has over 15 years of experience from the financial sector.	31.7.2019	1,5h
Technical expert 5	Expert is an entrepreneur and working with blockchain technology.	21.8.2019	1,25h
Technical expert 6	Expert has a background in insurance and has more than 10 years of experience from that field. The expert also has a deep understanding of blockchain technology and in expert's current role at a global insurance company the expert is combining these two.	29.8.2019	2h
Legal expert 1	Expert is a Senior advisor in digitalization at Finnish Financial Supervisory Authority. The expert is leading Fin-FSA's projects in the area of fintech and digitalization and represent Fin-FSA in international cooperation related to financial innovations. The expert coordinates Fin-FSA's input in preparation of legislation and policy in the area of fintech.	15.8.2019	1h
Legal expert 2	Expert works as Senior Financial Supervisor at Finnish Financial Supervisory Authority and has a strong background in Insurance.	15.8.2019	1h
Legal expert 3	Expert is a lawyer, contract innovator and a smart contract expert. The expert has multiple publications on new generation of contracts.	23.8.2019	1h

4.3 Analysis of the results

Data analysis follows common qualitative research analysis (Tuomi & Sarajärvi 2002, 104). First a decision was made on what is relevant in this material. That is all DAO-specific material, which means that the material concerning e.g. other new technologies were left out if it didn't have a strong link to DAO. Then all that material was collected to separate document, where it was classified by themes and lastly a summary out of these themes was formed. These summaries are presented in chapter 5.

The decommissioning of material is often started with thematic design. The collected data will be used to raise the themes that open up the research problems, by finding and distinguishing the topics that are relevant to the research problems. (Eskola & Suoranta, 2014, 176-180.) If the data is collected by a semi-structured method, the interview frame will be a good starting point for classifying the data (Eskola & Suoranta 1998, 153). Thematic design was used as the method of classifying the material in this research, and the themes were mainly derived from the interview frame questions. In addition, the regulatory perspective and existing companies utilizing DAO emerged strongly as separate themes from the data, which is why they were added to as separate themes. Table 5 lists themes used in analysis. Under these themes, written material from each interview was collected, followed by a comprehensive analysis of each theme, highlighting the major similarities and disagreements. In addition, if individual informants expressed a strong and well-reasoned argument, they were included in the analysis.

The analysis in this research is data-driven. In data-driven analysis the starting point is that the researcher is aware of his / her own preconceptions, assumptions and knowledge of the subject. By knowing these, the researcher must consciously forget them and allow them not to influence the analysis. (mt., 108–109.) However, this idea has been criticized for being a significant challenge (e.g. Salo 2015).

Table 5 - Theme categories used in analysis

Number	Theme	Sub-theme
1	Informants' understanding of DAO	
2	The impact of DAO in insurance value chain	
2a		Marketing
2b		Product development
2c		Sales
2d		Underwriting
2e		Contract administration / customer service
2f		Claims management
2g		Asset management
2h		Risk management
2i		General management
2j		IT
2k		Human resources
2l		Controlling
2m		Legal department
2n		Public relations
2o		Margin
3	Overall comments on DAO's affect into insurance value chain	
4	The disruptive potential of DAO in insurance industry	
5	Main problems for DAO adoption	
6	Insurance markets where DAOs hold potential	
7	Insurance markets where DAOs hold no potential	
8	Existing companies utilizing DAO	
9	Regulative perspective for DAO	

5 RESULTS

5.1 Informants' definition of DAO

In the beginning of every interview before going into actual questions, it was made clear that the informants knew what the innovation in question (DAO) is about. This is highly important for a successful research and makes different views comparable. Overall informants had been able to form a comprehensive understanding of what DAO is and the understanding deepened during the conversation. Understanding DAOs is not an easy task, and it is appreciated that informants had taken the time necessary to study, read the pre-material (see chapter 4.2) and conducting some thinking around the research questions before the actual interview. This helped the process and made it possible to get well thought views. DAO was only examined at a conceptual level, and deeper technical and other challenges were not addressed. At this point DAO was not limited for public/consortium blockchain, but it could work in both environments.

Several definitions of DAO were proposed:

"The DAO is an autonomous organization that does not contain human work, although it can use oracles and hence utilize human work."

– Industry expert

"The DAO is the capitalist's dream, a decentralized organization with such precise rules and where all the human capacity that has been reduced to a tube where they can try to make as much money as possible."

– Industry expert

"The DAO is an organization formed by the players in the DLT[17] / blockchain system to work with governance mechanism written in peer-to-peer smart contracts."

– Technical expert

"DAO is an economical community, an open source community with a stable economic exchange system."

– Technical expert

[17] DLT stands for distributed ledger technology. It is a term used to describe non-public blockchains.

Many times, the potential future insurance DAO was compared with the traditional insurance companies that currently exist and are the most common way to share risk. One of the common aspects that was mentioned in these comparisons by four of the informants was the potential for increased sense of community. One of the technical experts offered the following example on how the sense of community could be built. As the community would be digitally managed and all of the data would be stored on a blockchain it could be possible to record actions that have been done for the community. For example, if one of the members would help others, that behavior could be recorded and rewarded after a certain period of time. For example if there would be an DAO insurance pool for bicycles in a certain city, the members could share their tips on how to keep your bicycle safe e.g. sharing where are the best and worse places to left your bike, what type of lock would be the best one to use etc. The more you contribute, the more you could be rewarded.

5.2 DAO's potential impact on insurance value chain

As the DAO presents new to organize an organization, it must be examined how the DAO will differ from the mainstream way on organizing an insurance company (in this case). If the insurance company would be created in a form of DAO, it would need to manage some if not all of the parts of the insurance value chain. This chapter is divided between primary and support activities.

Informants views vary when discussing whether DAO would need to perform all or just some part of the value chain. Majority of the informants stated that DAO should somehow perform all value chain parts as it would not be able to make any part of the value chain irrelevant, even though large changes in some parts may exist. The large consensus was reached in that all activities are still needed, even if they were to be fully automated or outsourced. However, some informants disagreed and pointed parts of the value chain that could become irrelevant. Some of the examples were Human resources, General management, Asset management and Legal department (more information can be found on the sections below). One of the industry experts stated that support activities would eliminate if all primary activities were to be done in a decentralized manner. The elimination can be also seen as a strategic choice and therefore elimination would depend on the DAO's strategy.

Interesting possibility was raised up that the DAO would not potentially operate in a whole value chain, but form organization which includes just some parts of the insurance value chain. As others would not be included, DAO would cooperate with other organizations in order to be a part of offering insurance or risk sharing service. In that sense DAO could operate as business-to-business company. One of the informants presented that claim management itself could contain opportunities for DAO and another informant suggested that combination of sales, underwriting and claim management would be potential example of such DAO. If there are enough reliable and the right kind of data available the processes in

underwriting, claim management and sales could be coded and automated. At the simplest level sales can be restrict into including just signing as to become a member. Underwriting would be done based on the given data and set analysis. Same logic goes for claim management. For the clients (established insurance companies) it is enough that the process is managed well and according to regulation. If these apply, the insurance company is able to outsource part of its value chain. One of the industry experts stated that everything where a company is better than its competitors is profitable to produce itself, but where it performs poorly compared to competitors, it is profitable to outsource as much as possible. The same informant stated that in Finland insurance companies usually try to be good at every section of the value chain, and they are outsourcing only minor activities. Another industry expert stated that insurance companies should outsource everything that isn't bringing competitive advantage.

5.2.1 Primary activities

Marketing

Marketing was one of the most intractable sections for informants when discovering how different sections of an insurance value chain would transform through DAO. The majority of informants stated that marketing would not change significantly. Marketing itself is vastly changing in the current world, and e.g. smart marketing is bringing a lot of automation for marketing field. Like established companies, also DAOs could utilize this development.

One of the raised possibilities was that there could be interesting new opportunities for marketing in consumer interface due to utilization of DAO. If the DAO would be able to create a higher sense of community among insured, there could be potential for a new kind of discussions to take place. One of the industry experts mentioned that in modern insurance companies the discussion is mostly between the customers and company representatives and not between consumers. In DAO there should not be any central entity, but the system should be more network-like. The industry expert mentioned that this network could potentially improve the sense of community and it could lead into situation where marketing is occurring more through testimonials between consumers.

One scenario presented by another industry expert for a future DAO was that DAO wouldn't utilize traditional marketing at all, but only digital marketing instead. The digital marketing could utilize some kind of marketplace mechanics to leverage people to design marketing campaigns. Three technical experts and another industry expert mentioned this possibility on incentivizing members to create marketing activities. The industry expert stated that a compensation could be paid based on the effectiveness of the campaigns. The incentive mechanism in this type of operation would need to be carefully designed as marketing usually demands full time dedication to the matter. Alternatively, DAO

could outsource marketing activities for example to a separate marketing DAO or to a traditional marketing company. The expert stated that this is possible because marketing is not a core operation of an insurance company.

As a side note one of the technical experts mentioned that in the current world consumers are in some form forced to watch marketing material. If DAOs would become more common, consumers could be compensated for spending time with advertisements. In DAO/blockchain world this could be done through tokenized[18] incentive. Whenever people watch an advertisement or contribute to the marketing somehow, they could be rewarded with tokens.

Product development

Product development was one of the most thought and opinion provoking sections during the interviews. Legal experts in general thought that it would be very difficult for DAOs to bring significant value in this section since the requirement specifications for products are exactly the same regardless of the technology used in product development. An industry expert echoed this by stating that as long as insurance products are for people, they should be designed by people. On the other hand, most of the technical experts in turn could see multiple incremental benefits driven by the use of smart contracts (e.g. process automation) and simpler products process-wise and one industry expert saw an opportunity in more flexible product development than in traditional insurance companies.

Perhaps not so surprisingly, the industry experts had the most thoughts and opinions in this section. As one of the industry experts stated throughout history, insurance products have evolved through statutory requirements and legislation has played a crucial part in guiding the product development — hence, the legal experts' concern may not be valid enough to discard the potential of DAOs in product development. Additionally, the community aspect of DAOs provides ample opportunities for new product development opportunities altogether; products could be developed by the insurance community themselves, as there would be no organizational layer between the insurance community and the product development. Assuming a sizeable community of insured individuals, the potential for new insurance product ideas is likely significantly larger than within any individual company's R&D department. An industry expert proposed some kind of product development marketplace in which ideas and code could be produced and, for example, the community could vote on the what kind of products the DAO would offer. The amount of data automatically handled by the DAO could also be utilized in new product development — the more information and data the system has and collects of the insurance policies and claims, the more data-driven products can be developed leveraging the vast data pool. Additionally,

[18] In this research token is referred as a digital asset which presents some form of value.

products developed on DAOs could easily be replicated and improved on if the insurance products and the associated mechanisms are available in the open-source code of the DAO — however, it is another discussion altogether to consider the proprietary of DAO's product innovations.

According to one of industry experts earlier study on mutual insurance companies has found that as the company grows in size, the commitment and bond of its owner-customers weakens (i.e. people's connection with the company decreases) — DAO based insurance company may not face the same issues, as the organization (i.e. DAO) would not have to grow in scale as the size of the community grows. The importance of close customer relationships cannot be disregarded when products and services are increasingly customer-centric — as one industry expert outlined, being present in everyday life is about knowing the community and its needs. In banking, third parties have already come and taken over the customer relationships via value-added services, while the banks only handle the core banking systems in the back-end. The PSD2 regulation, which mandates open APIs for third parties to develop their complementary applications on banks' services, is an example of losing the close customer relationship to third parties. Owning the customer relationship is a significant competitive advantage in the market, as it fosters the community for ideas, opportunities for additional products and services to be sold and so on. The company who can build the toughest adhesive for consumers will be strong in the future, and if one wants to take the best interests of the community into account, it requires the close involvement of the community. Particularly in the insurance industry, one industry expert explained that as the market is shifting towards observing people's real-time behavior, consumer confidence in the insurance company must be extremely strong — the consumer must be able to trust that their data will be used ethically and morally, in addition to upholding to adequate information security standards, which is a notion independently expressed by a technical expert as well as outlined by the following quote:

"When such data exists on the servers of an insurance company, it is within their interests to use it, even if they did not have the permission. In a distributed environment, that is not the case."

– Technical expert

Traditional insurance companies cannot pursue smallness to foster the benefits of commitment, since they must be able to diversify their risk between people, organizations, insurance products, and regions. The smaller regional players, who have yet to suffer the drawbacks of large scale, often take advantage of a common central company for activities that require more muscle (e.g. investment activities and risk diversification). DAO, on the other hand, would be able to foster both the strengths associated with a tight, close-knit community, and the risk diversification of large-scale players.

Sales

Sales was one of the hardest sections on the value chain for informants to imagine in DAO. As a result, sales were described to be similar to existing solutions. In addition, one informant presented that even though DAO wouldn't necessarily maintain aggressive selling, it could find a way to utilize the community aspect like in the case of marketing was described. In this case incentives for sales activities would be needed. These incentives would most likely need to be in a level where professionals would be willing to give dedicated full-time work weeks for sales work.

One of the industry experts shared that most of the sales done in Finland currently are not coming from insurance companies online self-service portals. He estimated that the amount of new insurances from the online services is less than 10%, and that most of the new insurances come through agents. At the same time the number of people ordering their insurance online is growing. But it seems at the moment that if DAO would only sell insurances online, it couldn't reach the mass adoption now.

Underwriting

There were two main changes that informants were able to identify regarding changes happening in underwriting when moving to DAO. First one is the level of automation and the second is the continuity underwriting during the period of insurance. Automating underwriting functions is not nominal for DAO but could be done in other organizational forms and with other technologies as well. However, DAO seems to enhance automation and hence is worth of mentioning in this section as well.

Increased level of automation was strongly linked with the level of IoT data available. One of the presented examples came from trade finance sector: an insurance could start when a ship enters to the certain marine area and end when it leaves from that area. And if the ship never enters the specified area, the insurance would never take effect. This would be real-time and for-real-need insurance.

Another idea was to offer smart insurances for IoT devices themselves. In this scenario insurance products could react to situations when a defect is noticed. However, one of the industry experts stated that the growth of IoT devices will most likely decrease the need for insurances as insured events can be better prevented. The level of preventive mechanisms will most likely also increase competition in IoT insurance markets. This is currently happening in motor insurance as some car manufactures have pronounced that they will start offering their own insurances (see for example Tesla 2019).

IoT was strongly linked to second founding as well. Majority of informants mentioned IoT devises as enablers for automated continuous insurances. Traditionally underwriting has been done only in the

beginning of the agreement but if insurance provider could get continuous data, underwriting could be done potentially even in real time. However, in insurance there should be some level of ignorance present. If insurance provider could see the future and know who is going to be injured, there would not be a need for an insurance. Continuous underwriting could be possible in the automotive industry. For example, if the state will have an interest in tracking the usage of cars to calculate taxes based on pollution, it requires the collection of information. And if that information could also be used in the insurance industry it could open up new possibilities for underwriting in that sector.

In the current world the role of underwriting can be rather small for certain products. This means that underwriting means only that a checklist needs to be gone through in order to issue the insurance. These kinds of simple underwriting processes can be easily automated if the needed information is available. According to one of the industry experts in Finland auto insurance has already automated this way. But in a situation where this checklist is available for everyone to see (as it would most likely be in a case of DAO that utilizes public blockchain), cheating becomes easier when the author knows in advance what answers will lead to a certain outcome. There should be separate incentive mechanisms to prevent this kind of behavior.

It is believed that underwriting needs to be simple enough in DAOs. In the future, machine learning will certainly be able to better calculate the risks of events and enhance underwriting possibilities. But underwriting as a function is highly dependent on the risk-taking willingness of DAO token holders. So that should somehow be present in the algorithms and should be able to be changed according to the changing needs of the risk-takers. These risk-takers in the DAO may be needed due to the need of capital, and they could be shareholders, or in the mutual owned DAO it could be the clients. Acceptable risk selection rules may be voted on within the DAO community. Voting as such should not be necessary, but the DAO is likely to remain more upright in a changing world if it can be changed subsequently.

In an event where risk is shared between individuals and not transferred to an insurance company, the correct way to handle contracts would be having contract between all members of the pool. This multi-party signature could be automated once agreed standards are met and person is qualitied to be eligible to join that pool. In this scenario fraud prevention comes important. Again, Axa's flight insurance is a good example of a product where the need for liability is reduced.

Contract administration/ customer service

Contract administration is a point where DAO can streamline and automate processes. In peer-to-peer insurance there are multiple parties who agree to share their risk among each other. Contract verification may change if everyone in the DAO system carries a risk with one another. In a system like this, there

are so many contractors that contract administration becomes a challenge as all parties need to sign the contract when a new person is added to the pool. The number of signatures needed can be thousands or tens of thousands. Two of the informants (one technical and one industry expert) believed that future's peer-to-peer insurance will be post-paid rather than pre-paid. This means that the assets will be collected after an insured event has happened and compensations need to be paid. Three industry experts mentioned that in this kind of system the willingness to pay may bring up a set of challenges. In blockchain the payments could be enforced through smart contracts which would reduce this risk. In the current peer-to-peer solutions credit card bookings are often used. One of the industry experts mentioned that the potential enhance of communality in DAOs could highlight activities similar to peer support. This would be possible in a situation where insured would form a close and committed community. In that scenario customer support would transform into peer support.

Several informants believed that the need for customer service decreases and even disappears. This should be greatly reduced by simpler products (at least in the beginning) and digitalization. DAO could also utilize a chat bot technology to automate basic customer service functions as traditional insurers have done. One of the informants explained that customer service is usually needed when making changes to the contract, for example, beneficiaries or your home insurance address. But if this can be tracked automatically, there is no need for a customer service function in those common situations.

One of the situations where customer service would be appreciated is in the situations where the compensation decision is not the preferred one. One of the industry experts claimed that most likely insured should settle for the final result that has been decided by the DAO code, but there could be another organization that could provide insurances if a situation occurs where DAO has malfunctioned. Therefore, the insurance company itself could be insured. This insurance's insurance could also be provided by another DAO.

Ist important to consider whether there are legal or ethical issues with smart contracts. These networks of smart contracts can get really complicated when a smart contract can call another smart contract, etc. This results in the ordinary person not being able to understand that contract, but only by exceptional individuals with exceptional knowledge. In such situation, there will be need for a sensemaking service. Someone needs to write a plain language version of the agreement. However, this kind of service creates a new challenge. Is the creator of plain text responsible for actually matching smart contracts? There are widespread problems of understanding, interpretation and responsibility. These are all workable, of course, but the potential complexity of DAOs is notable.

Claims management

Automation of the claim's management process was the most significant change recognized by the informants in primary activities, as it enables significant cost reductions due to the reduced need of labor. However, it is somewhat misleading because as earlier described, technically automation is a separate development apart from DAO, although smart contracts are in key role in the development of DAOs as well. Yet the possibilities enabled by a network of interconnected devices is an intriguing prospect for the claims management in DAOs; e.g. if all shipments were network-enabled in a food cold chain, any incidents could be automatically recorded in a blockchain, and the respective stakeholders could be automatically compensated by the smart contract.

The smart contracts—and hence the insurance products themselves—are likely very simple in the first DAOs. While on the other hand this allows rapid development and deployment of DAOs, it also limits the possibilities offered by them as customer needs are increasingly complex. Subsequently, the emergence of aggregator companies seems likely due to the fragmented offerings — such aggregator companies could consider the customers' needs and combine the existing policies to suit the customer. The customers themselves would then only interact with these aggregator companies and receive a comprehensive package of insurance policies and products from a single provider.

The idea of a separate claim DAO was also presented. With a highly sophisticated claims management DAO in the market, individual insurance providers could reduce the strain on their own claims management function or ideally divest them entirely — according to one of the industry experts claims management functions within insurance companies do not create any additional competitive advantage over one another, so it would be logical to handle all claims using a shared system. This would also result in an enhanced fairness experienced by the end-users, as they can be more confident that the compensation, they will receive in an incident is not dependent on the insurance company or the person managing the claim. However, there must be a trusted entity that would resolve the claims that could not be automatically handled by the smart contracts. Voting among users is one option but the system must be built to honor the terms of the contract — it should not be possible for the voters to e.g. block a compensation because they would be unwilling to pay such a large sum. The entity resolving such cases should therefore be independent and should not include any incentives related to the outcome.

Additionally, the insurance companies would no longer have need of a separate payment department as the claims' payments could be automatically initiated. The DAO could independently check whether there's sufficient balance on the account, make the necessary currency conversions, and pay the network fees to the network operators. The incentive mechanism is an important aspect of the DAO's design to ensure sufficient processing power and reliability of the network — there are several examples of DLT

systems' incentive mechanisms (e.g. EOS and Ethereum), and many of those reward the operators using an on-chain currency rather than fiat currencies, but the choice of currency is a trivial matter compared to a fully functional compensation model. Some exceptions exist like IOTA where there is no direct incentive mechanism, but the transaction makers need to help in verifying for other transactions in order to proceed with their own transaction.

Asset management

The role of asset management was raised two separate and very strong point of views regarding should DAO's have asset management or not. The supportive view came mainly from the industry experts. They underscored that asset management is highly important part of the insurance value chain and system could not work properly without it. They raised up examples on InsurTechs who have neglected this part of the value chain and argued that the neglection of asset management is one of the main reasons leading InsurTechs to fail. The other point of view came from the industry experts who have been working with new business models. Their view was that changing the asset management part is one of the most significant innovations that new peer-to-peer models will enhance. In these systems assets would always be collected after insured claim has happened. In other words, these systems would not operate as pre-paid systems, but post-paid systems. Therefore, the system would not collect assets and there would be no need for asset management but only payment transfers.

If a post-paid system is used and only the equal amount of asset is paid that is needed for compensation payments the asset management will no longer be needed. In this case the system's balance sheet is not carrying the risk but the users are. On the contrary if the system collects payments in advance, it means that the system has some assets to carry the upcoming risks. In this case the balance sheet accumulates and according to insurance regulation it needs to start managing its solvency and assets. Industry experts mentioned that the assets are needed to equalize the variation of claim compensations. The two informants with background in InsurTechs stated that if the risk is completely diversified and independently of one another then it is nearly impossible for all members to become insolvent at the same time. Same informants and also two of the industry experts stated that in private insurance there are no large variation in the amount of compensations paid. For example, one of the informants gave an example of the InsurTech he founded, where the risk bearing capacity is 12 times the value of the expected compensations. This means that during the usual operation customers are charged approximately the expected amount but if something unusual occurs the customers can be charged 12 times the usual amount from their credit card. But according to the four informants the unusual situations never happen. One of the covers that the InsurTech in question offers is the cover for mellophone's glass. The probability for mobile phone glasses start breaking even 2 times more than what has occurred

in the last 5 years is unlikely without a clear reason and a major change in the environment or phones. Therefore, DAO is able to operate based on post-paid model.

Throughout the time asset management has been an important part of insurance business. The amount of regulation varies from region to region, but it usually states how much risk the company is allowed to take, how to allocate resources and what solvency to have. One of the industry experts mentioned that typically a significant part of the insurance company's profits come from investment income. If DAO would have asset management function, it could outsource its investment business to an investment company like some of the traditional companies, and this outsourcing management could be fully automated. The expert wondered that this might not be the best and a winning tactic in the market, but it should be pondered does it have to be, or would it be enough that the system holds enough funds to pay the compensation costs?

The asset management regulations are key tools for regulators. By regulating solvency capital, the regulator is able to ensure that the system is able to pay claims in the future. But if the system would have promise from someone else who would pay the claims as they occur, would the system not need these requirements? In this case one should somehow be able to track the solvency of those who are bearing the risk. For this thesis two InsurTech CEO's were interviewed and both of them use credit card booking in their systems. That way they do not need to ask permission to bill their clients as they are able to make these reservations directly. In both of the systems there has been maximum limit set for what is the maximum amount to be collected from the clients. By using credit card payment these InsurTechs also get solvent customers as byproduct, since in Finland one is not able to obtain credit card if they have any payment defaults.

However, if DAO would like to have pre-paid system instead of post-paid system, how would it work? Almost all of the informants agreed that it would be strongly automated. Asset management could be handled through algorithms that decide where and when to invest and when to withdraw. It remains unclear whether these systems would operate under regulations such as Solvency 2, but if they would, these algorithms should be changed accordingly. One of the industry experts mentioned that in the case of regional communities the main goal of asset management is to keep the assets under the control of the community, as it is necessary to maintain the regional vitality in which the insurance company operates. Investing locally at the community may be hard if not impossible to automate successfully at this stage.

Four of the industry experts argued that without asset management it is not possible to have insurance business. If asset management would be taken away from the value chain, the system would be something else than insurance. It would need to be called e.g. risk sharing services, but not insurances.

Insurance companies need to always have some level of wealth to be able to pay compensation. Asset management and investment can be outsourced in multiple ways. One of the possibilities to utilize DAO in insurance could actually be an asset management DAO. In asset management DAO the investment decisions could be highly automated. Majority of the informants also believed that full automation is possible, but in that case its impact on earnings is difficult to predict. And even though there is a lot of automation in current insurance companies already, that may not be desirable, because if and when something goes wrong, usually organizations want to know where the mistake happened, and who is responsible.

One of the insights was that if DAO would have asset management function there would most likely need to be someone(s) to manage the assets because distributing asset management to the network would become too complex. Even if there could be multiple investors, there should be someone/something that is managing the big picture and the solvency level. Otherwise the reliability of solvency can be too uncertain, and the system would exposure to the risk of insolvency.

If we run DAO with in public blockchain then the first questions to be solved in this section are:
1. in what currency are premiums paid? Euro or token? If token, what token?
2. If compensation is paid what currency will be used? Euro or token? If token, what token?

There are many ways to construct this part. The benefit of tokens is that they can be transferred in the network and they can be used to inspire desired actions. Contribution to the community could, in theory, be more than just checking out smart contracts. For example, if the bicycle is not stolen every year, or if a person lives healthily and informs the company about it, such actions could be rewarded automatically by the system. Thus, a level of custom economy could be reached. Additionally, if the system utilizes tokens, it is not limited to the rules and regulations that exist in traditional currencies.

Risk management

Risk management raised relatively little discussion. This is most likely due to value chain model (see Figure 2) where asset management and risk management were presented together, and more time was used on asset management side. A few informants mentioned that in risk management there would be quite small changes. It could most likely be more or less business as usual.

One of the biggest risk management tools in insurance is the solvency model. DAO's should form some kind of model for the protection of the system. And after all, internal models are already in use under the current regulation in EU and internal models can be built and approved by the regulator even in

current legislation. Therefore, DAO's may be able to operate under current Solvency regulation. But once the regulation changes, most likely there will be needed to change these internal models as well.

One of the ways for managing risk is to sell the risk forward. If the risk is sold on, many questions occur: in what form the risk is sold? Can we tokenize the risk and what does it entail? How are the regulations filled? How does the buyer understand the risk he is buying? According to one of the informants the risk tokenization should be regulated, but currently in blockchain world it is not. Although already there are market mechanisms available and risk can be shared. But it is seen that without sufficient regulation these functions would not last due to issues to be raised from asymmetric information.

5.2.2 Support activities

"In company's internal functions, where neither clients nor third parties are involved, it is hard to see direct benefit that DAO would bring. These would include all the support activities."

– Technical expert

General management

General management is likely to change whenever the organization change. Organization can produce the same product but in a completely different way. As for example one of the technical experts mentioned that the nuclear and solar companies produce the same end product (electric), but there is a great deal of difference in their operation which leads in the differences in the general managements.

Consensus among informants was that the role of general management will be strongly reduced if not eliminated. The centralized management would be replaced with a distributed and automated management. General management is seen to have a central role in building and initializing a DAO, but as DAO is launched that role will strongly weaken or even disappear. Management rules need to be prepared and coded in the system before DAO starts its operation and with for example a voting functions these rules could be changed afterwards. If DAO would have a general management function where certain people are able to use authority, it can be argued that it reduces decentralization and automation which would make the system no longer called a DAO. Responsible management makes the company more of a normally managed company.

The more operational activities people are given in a DAO, the more focus is needed on making sure that the needed skills are in place. There might be some operational tasks that cannot be entrusted to just anyone, as there is a risk of unfavorable decisions. For example, one of the industry experts mentioned that in Sweden people have been given the opportunity to decide where part of their pension

contributions should be invested. The experience showed that on average people could not make sound financial decisions, which resulted in lower pension funds than it would have been without this right.

One of the main tasks for general management is to create a strategy and make sure that organization follows it. If general management would no longer be present in DAO, something else has to come in its place. Another common task for management is to make sure that employees are doing the right things at the right time. In DAO people are not likely to be needed to manage that, because it could be automated with different incentive mechanisms (see the part Human Resources). In other words, leaders who maintain a bureaucratic model may not be needed in DAO.

IT

"IT will be completely at the center of the new organization. If it doesn't, we don't have a DAO. Companies become software companies, and the need for IT capability will be from another planet."

– Technical expert

One of the aspects that came up once in a while during the interviews was the question of DAO development. Because DAO is seen as a digital organization, development of DAO can be seen to belong under IT development. The role of IT provoked two different kind of standpoints. Some of the experts saw that DAO would need to be ready before it launches, and it would only get incremental changes after that. Others believed that development capability will continue after launch and that it would be one of the main requirements for DAO to survive in a long term.

The role of IT depends on the environment in which the organization operates. For example, in the current insurance companies if the organization wants to automate underwriting then IT would build a system for it, put it into use and start maintenance and most often development of the system. But according to several informants in a DAO this automated underwriting system (and protocols for its maintenance) should already exist. Of course, more developed DAOs where it would be flexible to make radical enhancements to DAOs could (and according to some of the experts should) exist at some point but in the beginning, they are seen as protocols where only incremental changes are made.

One of the most obvious aspects for IT in DAO is that decentralized system expertise is needed more. One of the industry experts stated that "bitcoin-like distributed system is needed", which means that the IT capability would strongly differ to what it is currently in a traditional organization. If the DAO doesn't wish to have that skillset in the organization, some of the IT processes could be outsourced or produced by using SAAS (software as a service) models. Some of the current IT systems may not be needed such as room reservation systems, work hour calculation etc.

Human Resources

Human resources (HR) was one of the most discussed part in the value chain. HR was many times described as an incentive designer function. HR needs to 1. make people want to do work tasks and 2. make people do the right tasks. DAO is not a network of machines, but a network of machines and people. The Role of HR is one of the most important functions in DAO especially if it utilizes human work. Different incentive mechanisms can be seen as HR's responsibilities. If the DAO will be developed over time, the need for HR as developers of the incentive mechanisms are needed. However, majority of the informants believed that DAO would utilize less human work than traditional companies and hence the amount of HR work needed reduces.

One of the industry experts mentioned that HR may not be needed in DAO but at the same time HR is more needed in DAO than ever before. By this the expert meant that if changes for incentives are not needed, the HR is not needed because compensation mechanisms can be coded and automated. And as there would be no changes made, the HR would have done its work. There were two technical experts and two industry experts who believed that DAO would not need HR after creating all processes. But if incentive mechanisms are wanted to be developed, there would be a need for HR and in that case the incentive mechanisms for doing HR functions would need to be in place as well.

In any case there have to be some incentive mechanisms in, and the quality of those mechanisms decide the future of the DAO. The incentive mechanisms need to direct the human activities but also attract the right kind of workers. If there are few people working in the organization, their skills or lack of them will have a major impact on the performance of the organization as a whole. Therefore, incentivizing of experts with experience could be beneficial for DAO in order to get more qualitative mechanisms. For example, a product developer who makes more than one product could be rewarded more than the product developer with less experience. A person gaining more experience might result better products than someone with less experience. If gaining experience is seen as a useful activity for the DAO, it could be installed with similar reward methods.

To have proper incentive mechanisms in place, it is vital for the organization to set the correct KPIs[19]. What is measured should be at the center of DAO design. In some traditional organizations one of the central KPIs is hours spent at the office. DAOs could utilize similar methodology, but it could be possible to measure the quality of the outputs as well. For example, marketing activities could be rewarded by the number of new customers gained. Two of the experts mentioned that if DAOs utilizes human work, it would need to select KPIs carefully.

[19] Key Performance Indicator

Controlling

Controlling was one of the least controversial part of the value chain. The main change in this section derives from transparency. As everything in the public blockchain based system is transparent, it has potential to strongly change bookkeeping. In general, the regulators and the public and stakeholders only get generated reports on financial data. Having every transaction data visible for everyone should ease the supervision made by regulators, users or other stakeholders. On the other hand, one of the technical experts mentioned that sometimes hiding information to open and available data can be and has been done in the past, and therefore transparent systems does not guarantee reliability. However conceptually if all data in the network is available in real time, different response mechanisms could be constructed.

One of the tasks of controlling section is to provide information for decision makers. But who is the decision maker in DAO? Another matter to be considered is that is the needed information same in DAO as it is in the traditional organizations where management is responsible for decision making? If DAO would not need any decision making as it would only execute predetermined matters, this need would be eliminated.

As utilizing blockchain technology, the data would be transparent, and the data lineage would be intact. All the needed reporting, data capture and analysis and measurement could be built before the DAO goes live. If that would be executed successfully, there may not be need for rotate of the numbers. All reports could be generated automatically, and possible funds distributed automatically.

Legal department

The most significant aspect to sway legal departments role in DAO is that is it considered to be under the regulation and if, witch regulation. The state of legal department depends on how firmly a DAO is wanted to be integrated into the existing business infrastructure. For example, if a DAO is not operating under any regulation, it cannot be a legal entity and therefore it has no responsible management level. In that case DAO is a system that just happens to perform certain activities according to predefined rules. It would have no legal responsibility and would not necessarily need a legal department. Of course, if the actors on this kind of a system are not anonymous, they may be held liable for their actions.

From the regulatory experts view DAOs should operate under some short of regulation. They saw that there will be increasing regulation in insurance markets and it will remain to be so for a long time, hence this department will definitely remain relevant in DAOs as well. In regulation there is always some room for interpretation and weighing up regulation, and this is usually done by a legal department. Also, the law changes continuously, which is why the code and processes of DAO needs to be updated. In other

words, new information and regulation is changing the operational environment as a result of which companies also need to change their operations.

In every regulative scenario the cooperation with ICT and legal is emphasized in DAO. Legal department requires knowledge on how to act in the interface between technology and legal challenges. This expertise is emphasized. As DAOs are built from smart contracts, the legal department is strongly needed when insurance contracts are created if smart contracts are used, because it is likely that they cannot be changed afterwards.

The number of disputes seemed to be one of the factors to determine the level of legal department needed. If some damage can be better verified in blockchains than in the past, then disputed cases may not arise in the same way. And it can ease the workload of the legal department. Another fairway for decreasing the number of disputes is to make simpler rules and products. If more room for interpretation in insurance contracts is wanted, then the system has a stronger need for suitably motivated legal experts. Most likely there will be no much room for interpretation in the first DAOs and hence the amount of ambiguity is drastically reduced. Therefore, the simplicity works also as a risk management tool. Sometimes disputes are dealt with in court and legal department may be needed there. Fighting in court requires quite a lot of resources, especially since this kind of DAO activity is not yet well established.

Public relations

The public relations (PR) raised rather less discussions. One of the tasks for PR is to communicate decisions made in the organization. In DAO however everything can be transparent and traceable, even the way how decisions have been made. One of the technical informant's point of view was that public relations are likely to become increasingly important despite the increasing of transparency. This is due to importance of semantic on top of the actual coded information. Managing meaningful content and maintaining reliability is vital for sustainability. Historically insurance is strongly national and regional, so companies tend to be involved in various CSR[20] matters and sponsor community sports or other activities. Would DAO's continue this behavior?

One of the industry experts pondered if public relations could be outsourced if there is an autonomous organization. That is because the public relations will probably happen before the DAO is released. But when the DAO is in operation, this could be outsourced to suitably intensified entities who would do their own campaigning and staging and reward them for results, as in marketing, for example. But in

[20] Corporate social responsibility

that scenario, there may not be need for separate PR section. Another industry expert agrees as PR integrates with sales and marketing.

Margin

The need for margin remains to exists and all insurance companies need to make some level of surplus. Aiming to the zero result is not sustainable states one of the industry experts. This statement assumes that the system works as pre-paid system. The organization has many options to utilize the margin. One of them is to strengthen the solvency buffer, another is to divide it for network participants such as developers, founders or initial investors.

When system is built, capital needs to be raised. And when capital is raised, there should always be a return on capital. To be able to make a DAO, a lot of resources must be used and by default there must be some margin for the one who invested in those resources. Either everything can be returned to the founders and start-up investors or some can be shared to the designers and distributed in a mutual-style to all clients. In principle the margin could be taken off as well, but all of the costs need to be paid including network administrators' fees (e.g. gas in Ethereum).

5.3 Additional differences between traditional insurance company and DAO

Many times, the potential future insurance DAO was compared with the traditional insurance companies that currently exist and are the most common way to share risk. One of the common aspects that was mentioned in these comparisons by four of the informants was the potential for increased sense of community. One of the technical experts offered the following example on how the sense of community could be built. As the community would be digitally managed and all of the data would be stored on a blockchain it could be possible to record actions that have been done for the community. For example, if one of the members would help others, that behavior could be recorded and rewarded after a certain period of time. For example if there would be an DAO insurance pool for bicycles in a certain city, the members could share their tips on how to keep your bicycle safe e.g. sharing where are the best and worse places to left your bike, what type of lock would be the best one to use etc. The more you contribute, the more you could be rewarded.

One of the changes is how human work is encountered. DAO shifts the focus of human work and how it is organized. One of the technical experts said that in a way DAOs move human work from the center of organization to the outer edge.

"*DAO brings a lot of efficiency by eliminating the need for traditional insurance companies. If the whole industry is considered holistically, DAO adoption would significantly boost the industry. Then it wouldn't take such big legions of people and organizations to make decisions and pay compensation and price products. Things could be done with fewer resources and the cost ratio would decrease."*

– Industry expert

With these kinds of changes that are described in chapter 5.2, the mindset of management will have to change. One of the technical experts compared the current situation into time period when hot air balloon industry was disrupted by airplanes. According to the expert the hot air balloon manufacturers did not see airplane innovation as a threat because they knew the old world so well and thought that they are on top of the game. According to the technical experts, the insurance industry may have a similar mistake in thinking.

" The blockchain is like an airplane wing during hot air balloon time. None of the manufacturers of hot air balloons and zeppelins became aircraft manufacturers but were wiped out. The idea of these companies might have been: "we are in the air freight business". When the more exact way to think would've been, "We are in the air freight business that is based on hot air balloon technology." Mental change and the inertia of the organization have been too great."

– Technical expert

Two technical and Three industry experts stated that technological skills must be at a higher level than before. Technological skills also help to better understand changes in the traditional insurance industry, but in DAO, technical expertise is emphasized. One of the industry experts underlined that at the same time, understanding insurance is really important and people with plain technology backgrounds will most likely not build the best solution without industry expertise. An informant who works as an insurance researcher noted that often InsurTechs neglect important background functions in insurance such as actuarial and investment and capital management and many times, that can lead to major challenges.

One of the technical experts mentioned that many times, change is slower than expected and even though DAO could be launched tomorrow, it will most likely be relevant further in the future. The expert also stated that in the long run, change can be more significant than expected. Today we can only see the very simple products going into DAOs, but we might see multiple other use cases in the future as well. Another technical expert pondered that each part of the value chain could first become a small DAO of its own, followed by the creation of a DAO of DAOs, which then acts as an insurance company. If there is such a big umbrella DAO then there could be rules for example, if a new more efficient DAO comes up with the same function or a set of functions, the DAO could change the underlying DAO providers.

5.4 DAO's disruptive potential in insurance industry

"I don't see this as disruptive yet. Given the misinformation and the need to prevent misuse, the use of this technology in the insurance industry is not yet in sight."

– Industry expert

"It will definitely disrupt the markets. The question is in what order. First the threat comes to simple products where the human factor is not significant. Examples include flight insurance or product-specific insurance that are highly parameterizable."

– Technical expert

When asked specifically about DAOs disruptive potential in current insurance industry, the answers varied a lot. However, most of the industry and legal experts were like-minded in believing that DAOs would not disrupt the current markets, but it could bring new products on the market. Some of the industry and technical experts believed that DAOs will disrupt the markets but it is not yet known when that could happen and in what order. Two of the technical experts were confident that DAOs will disrupt the industry.

Informants mainly believed that the disruption threat comes first to the simple products on the market where the human influence is not so much needed. Informants used examples such as a flight insurance or product-specific insurance which are highly parameterizable. On the life insurance sector there could emerge simple products that would pay lump sums in predetermined situations like in the event of death. Among the informants who believed DAOs disruptive potential they mentioned some following examples: Home insurance (especially zero click insurances[21]), optional pension and health insurance. Also, three of the industry experts mentioned that every product that can be automated can be easily exported to a DAO.

One of the technical experts compared the emergence of blockchain technology into emergence of internet's web pages. The first research papers regarding the possibilities of having web pages for companies argued that it would be beneficial for companies because product information could be shared through these web pages. This could lead into cost reduction as the need for printed product info materials would decrease. But at that time there was no mention of the possibility of selling products through the web pages. The social construction of how companies should utilize this platform was not yet formed. The value of selling through web pages is easy to understand today as we have companies

[21] A zero click insurance is an insurance that will come effective when certain conditions are met without further input for the insured/payer of the insurance.

such as Amazon, Google and Facebook, and we have understood how value can be created on the web, but this realization took 25 years. And there may be similar situation going on with blockchain technology today.

5.4.1 Markets where DAO could have opportunities

"In an essence every situation where a middleman is not adding value, DAO could provide a better solution."

– Technical expert

Many of the informants raised that DAOs would have most potential in markets where large pool can be formed, such as the personal insurance side, where systems currently control operations. On the business side insurance policies are more often personalized and the systems need to be able to adapt accordingly. One of the industry experts raised an opposite point of view on this and argument and thought that DAOs could provide more personalized products. This could be done if insurance products were to be formed from smaller specific products.

It is easy to think that the more information an insurance company can get, the better, as risk valuation and underwriting can be done with more accuracy. But during the interview process it was mentioned by one of the industry experts that some level of ignorance actually helps insurance. This is because if one can know exactly who will be affected by the damage, they should not insure it because it would be too expensive for them. And same goes for the ones who will not be affected: there is no point to insure the risk that will not occur. But the information asymmetry may also lead in a fraudulent behavior in the situations where insured knows that he is prone to a bigger risk than average and if he doesn't share this information, he will most likely get more affordable insurances. Fizzy's flight insurance is a good example of a product where asymmetric information is at its minimum. But in many other cases insurance companies have less information that the insured and if that is the case it hampers insurance pricing.

One of the industry experts stated that DAOs have stronger possibilities in situations where products include only pure data. If there is any kind of physical asset involved, difficulties raise on how to link them to the digital world. In a way this dilemma is the same as it is currently within the prediction markets. In chapter 3.3 is described how DAO called Augur answers this problem. The most obvious

environment for insurance DAO is to insure an event that occurs in the underlying blockchain (e.g. Ethereum or other blockchain where the DAO operates), because then there is no need for oracles[22].

While most of the informants spoke for new products and markets, some of the informants spoke for standardized and mature products in the current markets. They argued that products that are already fully automated, could be replicated through DAOs as well, hence in that case the only thing that needs to be changed is the implementing technology. In that sense there could be found some products that are so-called DAO ready. Next, we will go through some examples and characteristics needed in existing and new markets.

5.4.1.1 Existing markets

"Insurance is one of the activities where the DAO has the greatest potential because the original insurance business was a mutual or cooperative social activity."

– Technical expert

Two of the technical experts and three of the industry experts stated that DAOs could have potential in every market where mutual companies operate. One of these technical experts stated that the mutual company's journey to having DAO-like features is shorter than that of a corporativist because it already contains the idea of community action. Therefore, DAOs can find interfaces wherever there are cooperative activities. DLT can be used to form economic communities without a strong central player. Majority of the informants stated one of the following: there could be potential for DAOs where there is no insurance or where insurance is unprofitable or even too risky for the insured. For example, if it is unclear whether one will be compensated. One of the technical experts mentioned Venezuela as an example: there is currently a lack of confidence in the economy, and it may not be wise to use local currency to insure ones risks, because that currency contains too much volatility. Perhaps it would be more sensible to use tokens / cryptocurrencies instead.

The most popular example that was used by informants when asked about possibilities for DAO, was the case of an old travel insurance. Three industry experts and one technical expert mentioned this example. Many years ago, in Finland, it was possible to by a travel insurance from a vending machine. That machine would not ask any information on any aspects regarding the risks. That kind of simple machine has been proven to work and hence a similar process could be accomplished with DAO, according to these informants.

[22] "*Blockchain Oracle Definition: third party or decentralized data feed services that provide external data / off-chain data it onto the blockchain."* (Shermin 2019)

One of the markets where most of the informants saw opportunities for DAO was the reinsurance markets. Two of the industry experts saw that DAO could serve as an aggregator for insurance and reinsurance companies. Reinsurance markets possess simple processes and products, so savings based on efficiency are available. However, one of these industry experts also mentioned that reinsurance has administrations that have a full confidence in each other, which is why blockchain technology (and therefore DAO) may not be the best technology to provide these efficiencies.

Another idea presented by one of the industry experts was the contracting itself. The expert believed that DAO could manage the clauses of the (re)insurance contracts. There could be, for example, tens of thousands of clauses on which insurance contracts would be built. With new efficient processes it could be possible to have some new kinds of (re)insurance / risk sharing processes as well as new participants on that field.

Existing companies taking advantage of DAO

"The competencies upon which current insurance companies are built are diametrically opposed to the kind of expertise that DAOs need."

– Technical expert

"If an insurance company adopts a DAO, the company would gain a dynamic reputation, as insurance companies are generally not known to implement new dynamic technology. An intrinsic value would be understanding new technologies and maintaining competitiveness as learning about new technologies starts."

– Technical expert

The legal experts view was that DAO would be suitable for individual products as well as for companies that want to brand themselves as digital companies and be one of the firsts in line. This also gives the employer an upward look. Improving publicity is useful in the labor market. Two of the legal experts stated that while currently in Finland companies have a desire for new revenue, there is also a clear need in the industry to show that they are able to be at the forefront. In that way companies are likely to be at a competitive position in the future as new technology starts to roll out, if they understand new technologies.

Some of the potential lies within mutual companies that want to develop their operation or create new cooperative activities. DAO could potentially enable market expansion and cost savings. DAO could operate exactly where ever there is cooperative activity, and there is quite a lot of that in Finland. A

cooperative is an economic community, and these communities can also be made with the help of DLT. In this case communities just don't have a strong central player. In this scenario the technology just does more of the tasks that existing companies are commissioning people. Thus, the DAO could have opportunities in all traditional insurance markets.

One of the ways that established companies could test the new ways of organizing functions according to DAO is when going into a new market sector. As one of the industry experts mentioned that if operational mechanisms are waned to be changed, it is always easier to create a new company / department than is to change a traditional one. For example, if an established company were to expand into a country where it did not yet exist, then the DAO could be tested there. Then it could be tested if the business model works and is the established company able to gain market share for itself with DAO in a new market.

One of the industry experts stated that it is not feasible for existing companies to change their operation according to DAO model at once. But if existing companies could start to switch to the DAO model, and if regulators would allow that this change would be beneficial for the company and for its customers. This is due to lower costs enabled by automation and the point that DAO could bring something new for the consumer interface. Through DAO verifiably of events could become more efficient.

Compulsory insurance

Informants opinions have been varied on whether DAOs would be able to provide compulsory insurances or not. One of the industry experts stated that compulsory insurance is out of the question if the DAO were multinational. That is because compulsory insurance would be different in different countries. But if it would be a national product e.g. compulsory motor insurance in Finland, that could be possible, because then the dialog with regulators could be handled more clearly. The industry expert pondered that DAO’s potential in the current markets especially in the compulsory insurances is linked to the existing background organization. The expert thinks that there is more potential in the current market if there is a traditional company in the background. But in the new markets, there is potential even if there is no traditional company in the background.

Another aspect regarding compulsory insurances is the amount of risk. Generally, informants agreed that DAO has potential within products that have limited risk, a simple purchasing mechanism, low cost and low compensation. As mentioned earlier, several informants gave an example on such a product and that was non-life travel insurance. Typically, these insurances cost a few dozen euros and the maximum reimbursement is around few thousands. But as one of the industry experts mentioned, in a case of large risks such as in the Netherlands, for example, hailstorms can cause 100 million euros worth of damage

when destroying glass roofs in greenhouses. The expert stated that these large risks are not seen suitable for the DAO. The expert also stated that, for example, insurance of light motor vehicles was not seen feasible to be carried out in the DAO, because the insurance indemnities for light motor vehicles are paid at most during the rest of the life and typically the driver of such a vehicle is under 18-year-old. That would lead in a situation where the driver needs to be compensated tens of years. There are big responsibilities in motor insurance. Because of this, the expert couldn't see that DAO would have potential in compulsory motor insurance.

Of course, what is possible and what is not is always highly related to time span under review. However, there were some products which legal experts thought will never become feasible to implement with DAO. The two legal experts did not believe that statutory insurance will be transferred to the DAO because they are too challenging and complex. Examples for products that could not be implemented in a DAO were mandatory traffic insurance and the whole pension field. Experts argued that both of these products require stable and really long-term operation, they are not simple products, and being statutory, they need to be changed once in a while, which often results in different transitional provisions.

5.4.1.2 New markets

Majority of the informants agreed that DAO has the biggest opportunities in where there are no markets yet and new products are needed. Unfortunately, as one of the industry experts and one of the technical experts stated, this applies also into products against good insurance practices. Especially if the DAOs are outside the scope of regulation, it will allow such insurance policies to exist that are against good moral. As for example people who like to speed while driving could form a platform to insure speeding penalties. Another example are people traveling without a ticket who could insure themselves against penalty fees. Informants couldn't say if these kind of business models bring added value to the society or the opposite.

In the framework of insuring specific events, insurance becomes close to the prediction market (see chapter 3.3). The situations that are more granular (contextual) are more feasible for DAO's to insure than the standardized mass products, which insure a wide set of different events. In other words, if a customer needs insurance for more specific events, it may be facilitated more effectively in the DAO.

One of the industry experts mentioned that DAOs have potential in the new markets where players are also new. Microinsurance was said to be one of these. Informant believed that DAOs operational costs could allow providing of microinsurances more easily than established companies. Today it is not common to provide microinsurance products and that could be an interesting opportunity for DAOs. For informant it was easiest to see DAO in environments with huge customer potential, which would be

located across countries, and therefore geographically dispersed over a large area. In organization that wide, there would necessarily be problems with collaboration in case any human work is needed or if there are regulations to be followed. The products in this large system may be quite similar as today but DAOs could enable different risk carriers behind it - a network. Selling huge markets risk that pile up and bear the risk. The DAO could work between the insurer and the risk bearers.

Peer insurance

"Insurance is one of the activities where the DAO has the greatest potential because the original insurance business is a mutual or cooperative social activity."

– Technical expert

Several experts were particularly interested on DAO's potential in peer insurance. The idea of peer insurance is for a small group to come together and insure each other i.e. share together the cost of a particular risk. This was seen as an interesting way to gather the insurance community and provide insurance to the insured. One of the informants had been studying peer insurance companies and stated that while peer companies have been able to build new innovations at the consumer interface, less attention is often paid to other value chain functions traditionally held by insurance companies. Such as investment activities, claims handling, actuarial activities that are in the value chain for a reason. For example, if there is no investment activity, insurance activity is not as effective over the long run as it would be with investment activity. On the other hand, as previously stated, there are models in peer insurance where money is not collected until after a pre-arranged insurance event has occurred.

"Peer insurance can be successful when dealing with some specific products, but it seems that mass adoption of peer insurance is not a near future. But in a way, DAO would be able to build mutuality 2.0 through new technologies and could bring something new to the consumer interface."

– Industry expert

Voting is one potential way to conduct claims handling in peer insurance systems. In these systems, the compensation can be purely arbitrary. This omission has, forced peer insurance companies to cooperate with traditional insurance companies in order to carry out claims handling activities. In a DAO based peer insurance system there may face the same situation, where the consumer interface is organized in an interesting way, but many other functions are overlooked. Such functions usually are actuarial functions - how do we calculate the risk of something happening to someone - and solvency.

5.4.2 Markets where DAO could not have opportunities

The hardest question for informant to answer in the research was when asked where DAO doesn't have potential. It was easy for informants to come up with what difficulties DAOs will encounter, but when asked about barriers, most of the informants couldn't provide a clear answer. Seven experts stated that they cannot answer or that they cannot see where DAOs wouldn't have possibilities. Fortunately, there were couple of clear answers.

The pricing of products was most deeply encountered with the two informants who have been involved and established InsurTechs. One of them stated that DAOs have potential where they can provide significant cost advantages over traditional models. That would be in the most significant and expensive insurances, where prices are so significant that people are comparing the prices between different providers. If DAO would insure something inexpensive and not that important like mobile phone glasses, then it makes no difference for customer if DAO can offer the same product with a lower price if that price reduction is only a couple of euros. A slight reduction in price is not attractive unless it is directly comparable to other prices at the time of purchase. One of these experts didn't think that DAO can bring sufficient cost benefits because the potential would be around 10% price reduction and the expert thinks that is not enough. Two legal experts said the same as they are expecting the expense ratio to drop by 20% and perhaps even more anyway in established companies.

Two of the legal experts stated that pension insurance will be "the last dinosaur to stand" in Finland. That is because there are very strong interests for employees, employers and policy makers to have control over the pension system. These experts mentioned that one must also consider the customer's perspective. How can a customer trust the system? Because whenever something new comes up, there is a state of uncertainty for a while. Insurance such as aviation insurance is irrelevant from the customer's point of view, so the risk of new and uncertain organization behind it can be taken. But in the case on pension, it would be hard to see that individuals are ready to take the risk of giving their future pension only in a hand of a new technology.

In Finland's pension sector there are some monopolies such as Keva and the Seafarers' Pension Fund. During one of the interviews one of the technical experts stated that whenever there is a monopoly, there is a welfare loss. And if the modern society chooses to have that loss, it may be that the loss is acceptable because it will save the society from bigger losses. Therefore, we may have regulated monopolies. Pension insurance is highly regulated, and the law must be followed, and hence in these kinds of environments it is hard for the expert to see potential for DAOs. But as stated earlier the law changes and there is always a need to discuss the sustainability of the pension system.

In the interviews a popular view was that DAOs would have better opportunities in products for customers than with products for businesses. One of the industry experts stated that it is hard to see opportunities for any kind of business products. On the other hand, another industry expert thought that DAOs may have strong potential in insuring specific industries' specific needs. If these industry-specific corporate risks are sufficiently homogeneous and sufficiently high in corporates' interest, and if the operation is transparent, DAOs could possess strong potential. This is due to risks are understandable to all corporates since they are familiar with the environment and the risk.

One of the most obvious places where DAOs won't have potential is if there is an actor who doesn't want changes or who want to maintain corporativist activity. This point of view came up from two of the legal experts and one technical expert. DAO's will not have an actor with a lot of power over the organization, and therefore if some group doesn't want that to happen, then DAOs will not have potential. Same goes if customers don't want to start using new systems, but rather stay in the old way of insuring. But on the other hand, one of the technical experts pondered that if the system would currently work in a decentralized model and moved to become a centralized model, could it be argued that it would significantly complicate the processing?

One of the technical experts stated that in general, every time someone says there's something you can't do - there's an opportunity for disruptive innovation. But the laws have to be followed, and the same time it must be remembered that laws are constantly evolving. Therefore, it is challenging to say that there are some absolutely no go markets for DAO.

5.5 Perceived challenges and barriers for DAO adoption

"One has to ask: Why would DAO be better than a traditional company? There might be ideological and economic reasons. The biggest challenge is how do you get consumers excited? How do products become better? How does a decentralized organization bring cost benefits?"

– Technical expert

DAO faces multiple challenges if it intends to succeed in insurance markets. There are some technical and operational challenges involved, and many challenges raise from external stakeholders. DAO requires new operating models especially from consumers and regulators. In this section, only the greatest challenges are processed.

Mindset change

"There is a mind lock in insurance companies. The industry requires a big push from outside to develop. I don't see problems for DAO in terms of work, organization and technology, but I wonder: Should some non-insurance professionals think about these new models instead?"

– Industry expert

According to three industry experts and one technical expert the utilization of DAO requires a mindset change. This change needs to happen at least in the minds of insurance system creators, and the change needed from customers highly depend on the user experience and communication. Two of the industry experts mentioned that for established companies the mindset change may be too great. One of them stated that the mindset will not change until it is forced to be changed and the same mindset challenge goes for the regulators as well. One of the industry experts stated that traditionally everything that is not accepted in the regulation is not accepted. Regulators would most likely need to also think in a new and different way on how to regulate these new insurance DAOs.

Another interesting point of view by one of the industry experts was that one of the biggest barriers for DAO adoption could be the resistance of current operators. The regulator has power to prohibit the use of DAO in a specific location and the companies that are acting on that regulation has a level of power for the regulator. Therefore, the established companies have the ability to influence which new entrants get access to the markets.

Regulation

"The biggest problems for the DAO are the challenges posed by the regulator. The Solvency 2 and ORSA requirements are stone-cut and are not easily altered or twisted. And if the system is not regulated, then it is difficult to talk about insurance business. Then we should be talking about risk sharing or peer insurance."

– Industry expert

From the legal experts' point of view the greatest challenges emerge from the confluence of regulation and system creation. Overall the regulation has been tightened and for example re-evaluation of Solvency 2 is ongoing. However, the regulation is partly vague as sometimes phrases such as "need to be on a sufficient level" is used. Regulation thus contains some interpretation. Another reason for interpretation results from the use of directives instead of decrees at EU level. Decrees are laws that every country needs to admit as it is, and directive gives a framework which gives each country a certain level of room for interpretation. Interpretation is intended to be reduced and EU is moving from giving

directives into giving more decrees. Two of the legal experts believed that it will take around 10 years for DAOs to become relevant. This is in line with the Gartner's prediction presented in chapter 1.1.

One of the technical experts elaborated regulatory challenges: The challenges regarding regulator rise mostly from the uncertainty of what DAO is, because no one really understands that yet, and not all the innovations should be allowed to do what they want if we wish to keep society organized. This uncertainty that derives from novelty in turn leads to people being cautious. The third major challenge is that in a company-led environment, it's hard to bring in DAO thinking because it is challenging to understand what value it would bring. A new approach is often challenged on the basis of its previous dominant model by asking, for example, what is the efficiency gain compared to the current model. But what if that is not the right question? Of course, the DAO must be efficient, and nature also seeks efficiency, but here we mean extractive efficiency, where even the last few drops are intensified from workers. Cooperative activities should not operate on that basis because that could harm the community. The narrative change from current to DAO is great. The DAO is certainly not going to replace corporativist activity, but there will be new ways of doing things alongside the dominant ones.

Governance

"All systems naturally seek to create different forms of governance."

– Technical expert

One of the technical experts stated that the issues of DAO governance are not yet fully understood and all blockchain systems have rules and social rules around them. The expert states that the real power structure is always somewhere, and the line between centralized and decentralized system is not always clear. Therefore, the challenge is finding where there are orders for decentralized insurance providers. What is the value promise on decentralization, and does it exceed the potential downturns?

One of the technical experts stated that in the big picture, permissionless networks are a tool for deploying peer-to-peer networks and programming incentive structures to prevent the network from being set up. Incentive Structure Brings unknown people to each other to produce and maintain a technical architecture. But what it is worth to do with that architecture you can't say in many contexts. The social construction has not yet been clearly resolved. Therefore, one of the main challenges is that the social construction is not yet formed.

Social construction

The challenges raised from the novelty and a lack of understanding where and how DAOs could be utilized was raised in almost every interview. One of the technical experts stated that the main challenge for DAO adoption is the lack of social construction around DAO. The main problems to be solved are weather DAOs have any good use cases and people who are willing to use them.

Consumer perspective

"The biggest problem with consumer-friendly distributed networks is user management, access control and key management. So how do people integrate with the network, how are contracts confirmed, who has the right to contract, who doesn't? Who can provide insurance? Every grandma in Pihtiputaa should be able to use the system. The biggest challenge is precisely the commercial viability."

– Technical expert

One of the technical experts stated that in order to get mass adoption for DAOs they need to answer to the question why they are better than the traditional companies for consumers point of view. The answer can vary between ideological and economic reasons, but there has to be incentive for customers to change their behavior. The expert stated that the challenge of DAOs is that they are complicated to use from a consumer perspective due to novelty resulting as lack of consumer interest and incentives. If a DAO community is created it need to determine how DAO will be used, who creates interfaces and who can join in it. If a member contributes to the community, how that will be recorded and what the contributors will gain from it. If all of the functions are decentralized, it can cause usability problems. One of the industry experts wondered if even the blockchain experts know how these new organizations should work. And if it is not easy for even them, how could a layman understand the system? If the laymen are not able to understand the system, it is not easy to trust it and hence it may feel uncomfortable to start using it.

Usability was raised as one of the main issues. Consumer-centric distributed networks need to solve problems around user management, access control and key management. Often public blockchains are based on pairs of public and private keys. Private keys are known only for the holder of that key, and if that person loses the key, they cannot access to their public address anymore. This problem is not expressly DAO's to solve but is needed to be solved before mass adoption of DAOs. One of the technical experts mentioned that he biggest challenge for DAO is commercial viability.

Quality of information

One of the technical experts mentioned that in a case when an event needs to be verified the quality of the data become essential problem to be solved. If for example there would be a damage for physical asset, what kind of oracle would need to be utilized? The quality of the original information and the asymmetry of the information may determine the performance of the DAO.

As mentioned earlier, insuring of a physical asset is a challenge, as in that case some form of a digital twin[23] would be needed in order to have efficient fraud prevention mechanisms. One of the technical experts stated that without such digital identity the insuring of cars for example become challenging if not unfeasible. To have such mechanisms in place, there should be trusted network/entity who is maintaining these IoT identity platforms. Additionally, the identity data should be openly available for DAOs if they need it.

Technological maturity

Technological maturity has not yet been achieved, and scalability of public blockchains has raised questions among informants but also in other blockchain forums in general. Two of the informants believed that Ethereum could be used as a platform for insurance DAOs. One of them stated that Ethereum based system would need to pay the claims in Ether and that has its own hassle. The expert stated that the mass adaptation requires that the payment mechanisms are easy for customers and that the payments can be used to repair the damage.

5.6 DAO from a regulatory perspective

"The role of the regulator may also change from case-by-case control to running and simulating unwanted scenarios. At the moment, the regulator and auditor do not see much. Even in a case of blockchain currency like bitcoin, the regulator only sees transactions. A solution where all activities are public will change the behavior of the regulator. Instead of case-specific queries, there could be standardized templates for insurance products."

– Technical expert

Two of the legal experts stated the following: regulation in the insurance industry protects customers' needs and therefore strongly justifies its existence. The main justification to have regulation is that

[23] A digital twin is a digital replica of a living or non-living physical entity. By bridging the physical and the virtual world, data is transmitted seamlessly allowing the virtual entity to exist simultaneously with the physical entity. (El Saddik, A. 2018)

consumers need to be able to rely on the fact that if they pay insurance premiums, the insurance company is be able to pay their claims in the future. If these claims could not be paid, the system would collapse, and customers would suffer from it. To ensure this not to happen, regulators are traditionally needed.

For all legal informants the concept of DAO was fairly new and therefore challenging. The fundamental notion was that DAOs would change the regulation a lot. The current world relies heavily on reporting, stress tests and standard reports that companies have to produce. In the blockchain world, it should be assumed that the regulator can properly request or collect what is needed, or the system should produce it for the regulator. Due to the novelty of technology, legal experts expressed concern for a lot of open question. Legal experts saw that the role of a regulator could gain a set of new features due to DAOs and IT audits would require completely new frameworks because existing ones are not usable.

One of the concerns for legal experts was the funding of regulation. In Finland, financial regulation is almost entirely funded by financial sector companies through supervision fees. If regulation were to change a lot and regulators had to gain new skills and tools in order to ensure effective supervision, who would finance these changes? One of the possibilities is that the DAO would not produce the same kind of reports as established companies. If the report creation would be passed to the regulator, how would funding and organization be handled?

Another concern of two legal experts touches the skill side. Insurance is a highly regulated activity in the EU and many of the requirements concern top management skills and responsibilities. Insurance companies in Finland for example need to have sufficient expertise in the management of the company. If DAO would not have a managerial level, or working people at all, how can regulator ensure that DAO has sufficient expertise? Legal experts saw that the world of DAO would be different from the present from regulator’s perspective in multiple ways.

One of the legal experts mentioned that if current insurance companies in Finland went on to make any blockchain-based products, they would probably have to outsource the construction of the system, as they probably do not have the necessary capabilities. Insurance company law has precise criteria for outsourcing. Outsourcing must not weaken regulator's control capabilities, and the blockchain, due to its novelty, is challenging from that perspective. On the other hand, from the company's point of view, neither operational risk nor management risk should be increased. The new governance model introduced by the DAO is also new and its implications for operational activities need to be explored. In the current regulatory environment, responsibility must lie with the board of directors. In the view of the two legal experts, the current agreements are straightforward, and they lie in a clearly documented world. The blockchain is a new world and if companies start to utilize that technology, it means new processes and outsourcing agreements.

In many cases end-to-end automation comes up when talking about DAO. Legal experts mentioned that completed automation is not necessarily a desirable thing, as often different organizations want to know the responsible entity in a case of failure. As long as human writes the code, mistakes will occur which may escalate in non-desirable way. Especially in an insurance company operating environment where a lot of sensitive personal data is being processed and cyber risks are constantly growing and raising concerns.

6 DISCUSSION

6.1 Answering research questions

Herewith, in this section research questions outlined in chapter 0. will be answered. In order to answer the main research question, the four sub-research questions need answers.

1. What is the impact of DAO to the insurance value chain?

In the
Table 6 - The changes in insurance value chain by DAO
the most significant changes in insurance value chain by DAO are reflected.

Table 6 - The changes in insurance value chain by DAO

Value chain process	Tasks	What is DAO's impact to insurance value chain
		Primary activities
Marketing	• Market and customer research: researching ideas for product development • Analyzing target groups • Development of pricing strategy for product sales • Designing of advertisement and communication strategies	• Marketing will remain more or less same as it is in the established companies. • All options would be more or less the same for insurance DAO's than they are for more traditional insurance companies. • If DAOs were able to raise a sense of community, marketing could occur more through testimonials between consumers. • If DAO would build in marketing function, this could be done through incentive mechanisms where the creator of a marketing campaign would be compensated based on the impact of the campaign.
Product development	• ''Manufacturing'' the products • Product pricing • Check legal requirements	• Product development by the community
Sales	• Customer acquisition, consultation • Product sale • After-sales	• Sales would not be much different from the current operating model. • Incentives for sales activities could be build. • The number of online sales in Finnish insurance industry is still fairly low, and hence if DAO would sell its insurances only online, it couldn't reach mass adoption at this stage.
Underwriting	• Application handling • Risk assessment • Assessment of the final contract details, if necessary, ask for more information	• Underwriting in DAO would be mostly automated. • Underwriting would potentially become more continuous if the usage of IoT device information would be present. • As underwriting reflects the risk-taking willingness of the risk-takers, it should be able to be changed over time.
Contract administration/ customer service	• Change of contract data • Answering customer requests regarding the contract or other purposes	• Streamlining and automation of a contract administration • The need for customer service decreases
Claims management	• Investigation of fraud • Claim settlement	• Enhanced automation • New models for claim settlement
Asset management	• Asset allocation • Asset liability management	• The need for asset management decreases • In a case of post-paid system, investment functions would be eliminated • Asset and risk management is simplified.
Risk management	• Analysis and management of all risks	• Significantly reduced through automation • Preventive mechanisms could occur if sufficient amount of real-time data is available. • New models for selling risk forward
		Support activities
General management	• Strategic planning and implementation of company goals	• The role of a general management will reduce significantly. • General management may have significant role in the beginning, and decrease as the DAO matures
IT	• IT procurement and installation • IT service & support • IT development • Coordination of IT processes	• The need for decentralized system expertise increases
Human resources	• Planning HR development • Job interviews • Job market advertisement • Job training	• The amount of work is diminishing, the importance increasing. • Incentive design becomes the most important problem to be solved
Controlling	• Data capture and analysis • Reporting • Business-KPI measurement	• The role is diminishing, the importance decreasing • The need for human work will decrease • The trust in the numbers increase due to transparency offered by public blockchain
Legal department	• Dealing with legal effects	• The role highly depends on the relationship with regulation
Public relations	• Press/investor management	• Will remain relevant
Margin		• Will stay relevant • The usage of margin would most likely mimic today's mutual insurance companies

2. How does DAO align with the characteristics of a disruptive innovation?

The second sub-question aims to clarify if DAO aligns to the characteristics of a disruptive innovation. As mentioned in chapter 2.5.1 disruptive innovation can appear in two ways. Firstly, disruptive innovation can appear in a situation in which there are over-looked segments in the market. In this case the entrant is able to create a new and a better product for low-end customers and as it evolves, it is able to move up-market. (Christensen & Raynor 2003, 43 - 49.) Based on the empirical research, this option seems possible, but it is hard to form a clear view of its likelihood. The products offered by DAOs are seen as simpler and offering more specific covers than traditional insurance companies. Therefore, DAO seems to fulfill a place in the market that is not currently fulfilled, but it remains unclear if there are customers in those sections.

Secondly, disruptive innovation is able to appear when markets are created where there were no such markets before. As this new innovation evolves, it is able to attract customers from the original markets as well. (Hopp et al. 2018) This second way to create disruption seems more likely for DAO than the first option. Majority of the informants raised up that DAOs could have potential in the new markets. But it remains unclear if the DAO could develop to attract customers from original markets.

In the case of new market disruption, products and services often become more affordable and easier to use, which allows the use of these products for new customer base. As for DAOs, it is too early to say how much more affordable products could be offered or are they able to race in the price competition in the beginning at all. However, majority of the informants seemed to believe that DAO has potential to operate with a lower cost in the market than traditional companies. The ease of use entirely depends on how the user interfaces and processes are created for the DAO. But most likely DAOs will be fully digital companies, which is the direction that current organizations are slowly changing into. It would be intuitive to say that an organization that is digital by design could better serve customers in the new digital age than a company that is not. However, this is only speculation of the researcher. In essence it can be said that DAO aligns to the characteristics of a disruptive innovation.

3. In which insurance markets does DAO have potential opportunities, if any?

The third sub-research question concerned the potential of DAO in the insurance industry. Overall findings on potential of DAO in insurance markets were fairly clear as it was rather hard for informants to point where DAO possess no potential. But having potential that is disruptive requires deeper interpretation. As informants' view on disruptive potential of DAO varied substantially, it could not be verified based on this research that DAO will or won't be a disruptive in insurance industry. Some informants saw that it is likely and one of the technical experts even saw that it is inevitable. These

informants were able to identify some insurance markets where they believe DAO could disrupt the market. On the other side some informants said that currently DAO doesn't seem to be disruptive. It might be too early to get a clear answer to this question, and therefore further research is needed after DAOs have been developed further.

4. What are the main conceptual challenges for DAO adoption?

The fourth sub-question aimed to find out the main challenges for DAO adoption. This is because the number and level of identified challenges would help us to evaluate the DAOs disruptive potential. If a such challenge would occur that couldn't be solved, it would help us to valuate that DAO is unlikely to be disruptive due to these challenges. Seven categories for challenges were identified as DAO was only viewed on a conceptual level. There might be for example deeper technical challenges that were not mentioned in this section that could prevent a level of DAO's potential. However, in this research informants were not able to identify such problems that couldn't be solved. Therefore, there is no barriers raised in this section that would reduce DAO's disruptive potential. Rantala and Pentikäinen (2009, 149–150) suggested that one of the biggest risks of insurance company is the random variation of the amount of the reimbursement expense at different times. One of the empirical findings was that this is not seen as a likely threat. Three industry experts mentioned this risk but strongly stated that it does not present a threat for DAO.

Based on the answers to the four sub-questions the main question can be answered. The main question was: what is the disruptive potential of DAO in insurance industry? The main finding is that it can't be said that DAO doesn't possess disruptive potential in insurance industry. However, evaluating the disruptive potential itself cannot be done as the third sub-research question did not provide a clear answer to this. As a big picture description DAO holds potential where there are simple products with a little amount of asymmetrical information.

If DAO is seen as a form of InsurTech, we can review it from the perspective presented by Eling and Lehmann (2018). They argued that disruption is unlikely to come to the industry through InsurTechs due to four reasons: (1) established companies are able to copy InsurTechs' business models, (2) established companies have the possibility to acquire InsurTechs, (3) InsurTechs are more focused to cooperate rather than rivalry with insurance companies and (4) the strong entry barriers caused by the regulation and unsolved legal questions. (Eling & Lehmann 2018) In a case of DAO the first two arguments became invalid. DAO is a separate organization and for established companies to copy that business model might not be meaningful. Also, DAO cannot be owned by any one entity, as in that case

it is not seen as a distributed organization. Hence it is not possible to acquire DAO[24]. Instead the willingness for cooperation and the strong entry barriers of the industry remain as unsolved issues for now.

6.2 Research evaluation and critique

This research was able to answer to the research questions and can therefore be seen as a successful research. The concept to be researched was not the easiest to study due to its novelty. It was not easy to find suitable informants, although the end result is satisfying. The optimal informants would be ones who are able to understand both insurance industry and blockchain technology on a deep level. Because finding enough such experts was not possible, the requirements for informants were set as described in chapter 4.2. Because insurance industry was the center of the research, more industry experts were chosen to be part of this study than technical experts. Having industry, technical and legal experts balanced empirical material was achieved.

Generally speaking, in qualitative research, the amount of gathered data does not have immediate effect on to the success of the study (Eskola & Suoranta 2014, 62). The number of informants (17) and the total length of interviews (over 22 hours) in this study can be seen appropriate and sufficient for this study. The selected method of data collection could have been enriched with the material available on insurance DAO projects. This would have led to even more extensive empirical material base but could have biased the results as there are financial incentives for those projects to believe to the disruptive potential of DAO. In this case, DAO would have been seen most likely in a more positive light than it is in this study.

The analysis in this research was data-driven. In data-driven analysis the starting point is that the researcher is aware of his / her own preconceptions, assumptions and knowledge of the subject. By knowing these, the researcher must consciously forget them and allow them not to influence the analysis. (mt., 108–109.) However, this idea has been criticized for being quite a challenge (e.g. Salo 2015). During the analysis I refrained myself to give emphasis on my preconceptions, assumptions and knowledge of the subject. It is still hard to estimate how much these factors unconsciously affected in the analysis phase.

One of the main pain points of this research is that the term DAO is not established term. It might have been beneficial to give informants a more limited definition of DAO, and it could have generated clearer

[24] In theory, it is possible to do what is called 51% attack or otherwise use plutocratic methods to "acquire" DAO, but in these scenarios it becomes unclear whether this kind of organization can be called decentralized.

point of views. As DAO was not strictly defined, the ideas around DAO were vast. However, this can also be seen as a positive thing, as it reveals how informants see DAO at this state of time. Overall informants had a good understanding on what is meant by DAO, but many times during the conversations DAO was assimilated into either distributed organization or automated organization. In these cases, the question "Is this specific for DAO or is this something that established organizations could do as well?" was asked and often times the answer was positive. This confusion of terms was expected due to novelty of the term.

The differences in mindsets were most insightful findings for me personally. As an example, the visualization of insurance DAO seemed to be most challenging for legal experts and easiest for researchers. Researchers could examine DAO from multiple aspects. In one of the interviews with a researcher and holder of a PhD the informant stated that InsurTechs usually have neglects with actuarial functions and implicated that these functions would need to be done more or less in the same way that it is done on the traditional organizations. However, when one of the InsurTech CEO's was interviewed he shared a mechanism that does actuarial efforts in profoundly different way than traditional insurance companies and still ends up literally to the exact same results as traditional insurance companies. Details were agreed not to be shared in this study.

6.3 Suggestions for further research

As DAO is a fairly new subject for research, several suggestions for future research can be given based on this research. The results of this research may prove themselves beneficial for insurance professionals in order to better understand what DAO could be in insurance context. Other industries may find it beneficial as well if similar research were conducted in other industries.

This research focused on the future of DAO, but as there are several ongoing DAO projects in insurance field, a case study on these projects could offer deeper information on how DAOs are used today and how they have been used in the past. This study could offer information on how DAO has been able to achieve e.g. cost benefits that it promises to bring.

As stated in theory, the insurance risk transfer value chain suffers from drag coefficient and a troubling trust deficit. One of the findings from the empirical research was that DAO may offer opportunities for efficiency. But in order to understand trust aspect, more research in insurance context is needed around DAOs. Are people ready to trust on these new types of organizations rather than the traditional ones? Following the previous, studying deeper on the potential governance mechanisms could offer tools for deeper understanding of these organizations.

7 CONCLUSIONS

Informants' understanding of DAO aligns with the DAO theories. As a big picture description, DAO is seen by all informants as an organization that has found codable ways to execute functions and incentivize members to act according to desired operating model. As discussed in theory, in spite of digitalization, most insurance processes will require some amount of manual work. The results of this study implicate that the same is true in case of DAO. It can be argued that every traditional organization is actively founding ways to incentivize its members, but the difference to DAO is that in DAO these mechanisms are hard coded in the system and for everyone to see. In a more traditional organization, many times the incentives e.g. salaries and other incentive mechanisms are not as visible.

Disparte (2017) states that blockchain technology has the potential to make radical changes in the whole value chain of insurance by improving transparency in operations and outcomes. The results of this study align with the belief of radical changes to the value chain, but without specific emphasis on transparency. Results indicate that in case of DAO support activities change completely, as the business (through primary activities) changes. There are functions like HR and general management that might even not be needed. The primary activities were seen to remain albeit they are likely to be changed and automated. However, majority of the informants stated that there is no section that would become irrelevant. It is just a matter of selecting strategies and hence there are no parts DAO as such would make irrelevant.

There were three main directions in the experts' opinions on how to exploit a DAO in insurance: (1) peer-to-peer insurance models, (2) existing companies as DAO exploiters and (3) new markets. Many times, the idea of peer-to-peer insurance came up during the interviews. It is important to recognize as one of the potential use cases for DAO, but as important is to recognize that it is not the only potential way to utilize this innovation. What is meant by peer insurance in this context, is a group of people with similar risks coming together and wanting to insure each other. As one of the industry experts stated, this is what mutuality is all about and in this sense digitalization and DAO is able to bring out an old idea that is executed in a new way.

In the beginning, the researcher had not thought that established companies could potentially utilize DAO in their business. As mutual insurance was recognized to have many resemblances to DAOs, it opened up this new space. Existing companies' utilization potential of DAO came out in the fourth interview and it was featured in five interviews after that as well. In essence, it seems that traditional companies may utilize DAOs in three different ways: (1) internal startup for certain products, (2) as an

entity to which a particular part of the value chain is outsourced, and (3) in a way we don't know yet. The last one raises more questions than provides answers, but it is important to recognize that when we are dealing with new innovations and new technologies, it is likely that we don't yet know how they will emerge and in what ways they could be utilized. Four of the informants believed that DAOs will be utilized by traditional companies in ways which we do not yet know.

The third aspect for DAO utilization was new markets. One of the industry experts stated that DAOs have stronger possibilities in situations where products include only pure data and the most obvious environment for insurance DAO is to insure an event that occurs in the underlying blockchain (e.g. Ethereum or other blockchain where a DAO operates), because then there is no need for oracles[25]. Using oracles would make the system more complex but would widen the possibilities. And if oracle's oracles could be used, there may be found even wider range of possibilities.

Decentralization in theory is seen as a powerful tool in insurance business when it comes to asset and risk allocation, as that enables decentralizing the risk and therefore stabilizing costs. If DAOs are better able to reach higher state of risk and asset decentralization, it would get an advantage over traditional companies. In Finland, insurance companies usually operate only in Finland or in the Nordics/Baltics and therefore DAOs could hold more potential for decentralization. Decentralization in operation, however, is a newer idea and a center of this research. One of the technical experts mentioned that DAOs and decentralized system would bring benefits only in situations where there is clearly some harm in concentrating. However, the expert was unable to showcase an example for such markets.

The common idea was that DAOs seem to be better suited to non-life insurance than life insurance. This is due to complexity of the products differ as life insurance products can be highly complex, expensive and long lasting. Non-life products instead are often one-off compensations, and therefore much simpler. In relation, DAOs were not seen as entities that insure large risks. Informants spoke a lot for simple products to be offered by DAOs because the level of complexity of the technology and smart contracts are already significant. And if the products were to be make complex, the less likely it is that DAO will be of any use, as the complexity brings more weak spots. In other words where there are short and simple insurance contracts, there may be an opportunity for DAO. But it can't be said that DAO solves some current problems because it makes products to be simpler. DAO could make some really simple products, but if it aims to disrupt the current insurance market, it needs to tackle issues in a more complex environment as well. In most of the cases insurance systems are social systems where people have

[25] "*Blockchain Oracle Definition: third party or decentralized data feed services that provide external data / off-chain data it onto the blockchain."* (Shermin 2019)

discussions and interpersonal action is discretionary. One of the technical experts believes that it is very difficult for the DAO to bring cost benefits because of this.

In a case of health insurance, the system would include continuous data gathering, pooling, and analyzing of the information. These kinds of products can be found from the market today, but they are not yet reached the potential that has been set for smart health insurances. One of the reasons could be that people don't wish to share their information with insurance companies since they believe that the company could use the data against them. In theory it has stated that the core value of blockchain technology is to allow trust by replacing an arbitrator with a digital substitute and central authorities with algorithmic trust among distributed peer-to-peer networks (Järvenpää & Teigland 2017). Therefore, if there would be a DAO, that is immutable and only uses the information in prediction purposes for benefit of the insured, the insured may be more willing to give her data for this use. In other words, as DAO is coded to execute a certain function and only that certain function, one could trust the DAO more than she can trust the traditional company.

The most used example for DAO's potential in insurance was the case of a vending machine travel insurance-like product. Apparently, this is seen true regardless that it is assumed that travel insurances are affected strongly by fraudulent behavior. As an example, one of the industry informants stated that Rolex -watches are being stolen more than they are sold in Finland. The same informant estimated that 25% of the claims paid from travel insurance were at least partly paid due to fraudulent behavior. Therefore, even though travel insurance is heavily affected by fraudulent behavior, it is still able to be successful product and one that DAO could manage.

The question around DAO's development raised up in multiple sections. There were three ways on how informants believed DAO could develop: (1) there would be no developing opportunities at all, (2) incremental changes could be possible and (3) radical changes could be possible. Incremental changes are referred as minor changes in the current rules. The radical changes are referred as new rules and functions. It raises questions whether a system that is unable to develop over time would manage to stay relevant in changing environment. One of the technical experts mentioned that like all living organs and all systems, DAO will most likely strive to break down and therefore try to get back to its natural (non-existing) state. Therefore, one must work to keep the organization together and no organization is ever complete. Therefore, it is likely that sustainable DAO would be able to develop at some level.

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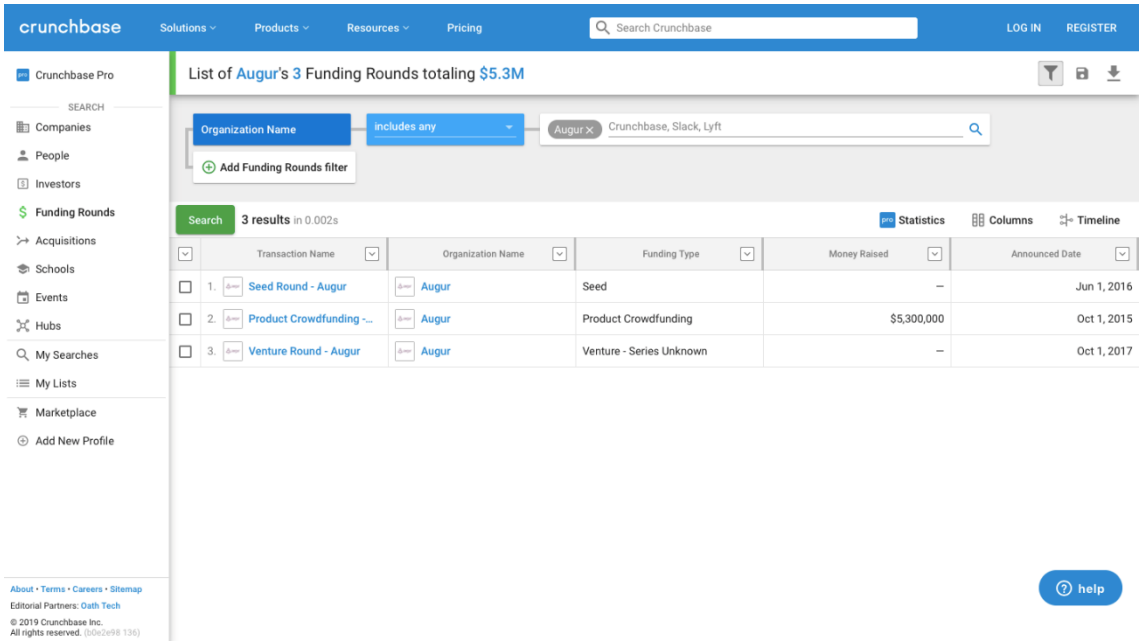
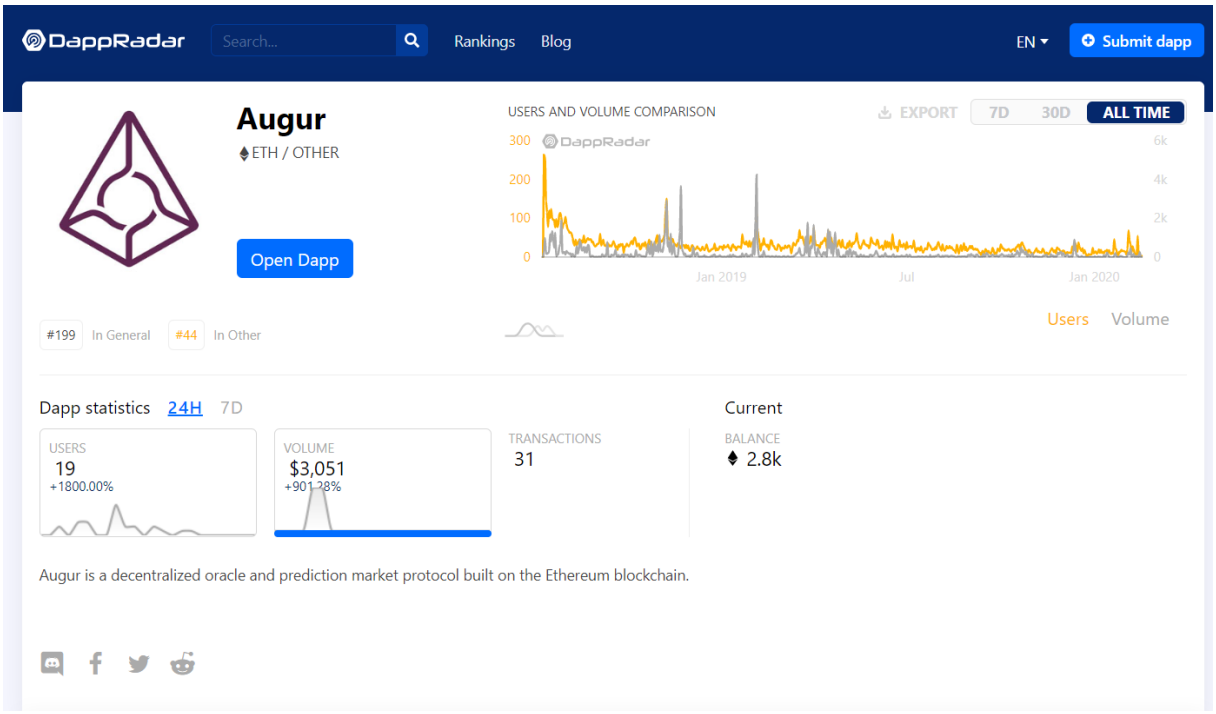
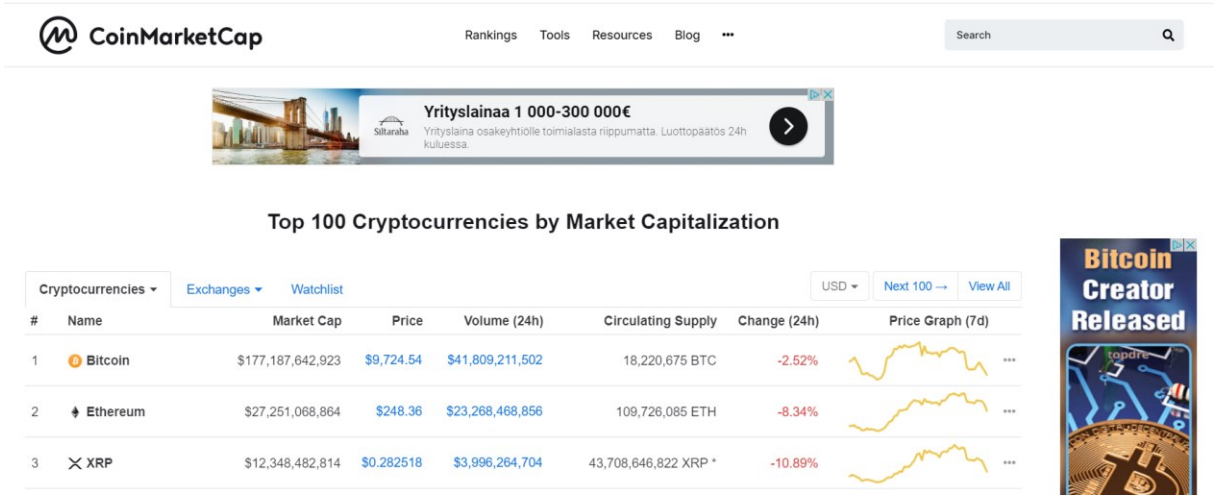
ATTACHMENTS



Attachment 1 - Augur's raised funds



Attachment 2 – Screenshot of Augur's volumes on 26th of March 2019



Attachment 3 - Screenshot of CoinMarketCap 26th of March 2019

Attachment 4 – Interview questions

1. Activities of insurance companies can be classified as follows:

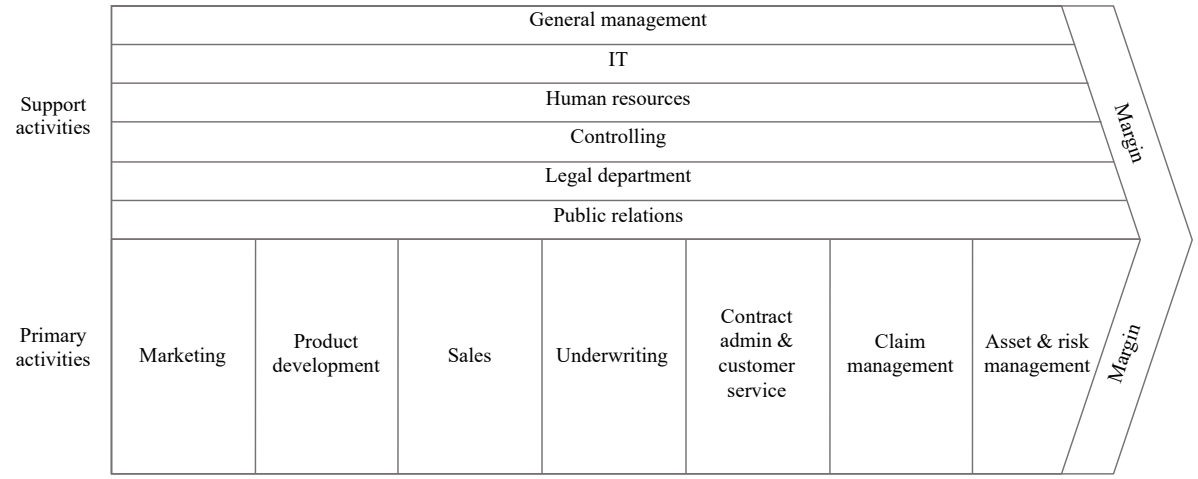


Figure – Insurance-specific value chain based on Porter (1985) and Rahlfs (2007).

a) In which sections and what value DAOs can bring in this classification?
b) Does DAO have potential to make some parts irrelevant?
c) In which sections and with what functions DAOs have challenges in order to offer insurance coverage?

2. In which insurance markets do DAOs have potential opportunities, if any? Why?
3. In which insurance markets do DAOs have NO potential opportunities, if any? Why?
4. In which ways and in which insurance class (products) DAOs could disrupt current insurance markets? Why?
5. What are the main challenges for DAO adoption? Why?

Attachment 5

Explaining DAOs to a non-technical person in 10 points

Maciej Olpinski
Apr 13, 2016 · 2 min read

I'm seeing a lot of questions about DAOs on Reddit and elsewhere. So, I've decided to offer my explanation — hopefully, it will help someone to better understand this complex topic.

1. DAOs (Decentralized Autonomous Organizations) are mechanisms by which we can **align economic incentives (distribute risks/rewards) over the Internet using software**. Using DAOs, humans can coordinate themselves to work towards a common goal at the global scale without relying on trust or third parties. This mechanism has been enabled by the invention of the blockchain, pioneered by Bitcoin.

2. The **'alignment of incentives via risk/rewards distribution'** is a fundamental purpose of a DAO. Some participants in the DAO will seek to take more risk today for the expected higher reward in the future, other participants will seek to minimize risk today by sacrificing future rewards. If incentives are compatible, then each participant will contribute to the DAOs purpose, just by working to maximize their own interest.

3. This is nothing new. We've been doing this for centuries using inventions such as joint-stock companies, insurance schemes or even nation states. Groups of people sharing a common goal pool resources together, agree on risk/reward distribution and enjoy the benefits (or not) of the shared activity in the future. This way humans can cooperate on a large scale and align incentives between individuals who never met each other face to face.

4. Nation states, joint-stock companies, corporations, insurance companies are just a few examples of 'inventions' that allowed us to achieve large-scale cooperation. Essentially, they are just **abstractions that we use to organize ourselves to collaborate**. But their function is no different from the function of DAOs, but technologies used to implement them are different (paper, print, enforcement by the judicial systems).

5. While we've mostly replaced paper & print for transferring information, we still use print & paper for aligning and communicating economic incentives (the entire legal system).

6. Bitcoin proved we can align incentives using just software, without third parties, to achieve a common goal of creating a digital currency with gold-like properties. We might call Bitcoin a proto-DAO. It proved that a certain design pattern is possible and works in the real world.

7. Ethereum takes this concept to the next level. Ethereum provides a platform to coordinate ourselves to achieve economic goals other than just currency creation.

8. Ethereum is to DAOs what Blogger was to publishing. It allows everyone to code economic incentives without having to build the underlying delivery infrastructure from scratch.

9. The Internet allowed you to exchange information with anyone in the world at no cost. DAOs will allow to your exchange economic value with anyone in the world. That means to invest, raise money, speculate, trade, get insurance, lend, borrow, get paid, form joint-ventures in ways that were impossible before. Generally, make a living in a digital world of the future.

10. It's early, it's risky, it's a Wild West. But this is the way, the global networked economy will create value in the future.

Available: https://medium.com/@maciejolpinski/explaining-daos-to-a-non-technical-person-in-10-points-9a9618e718e8

&

Tokenized Networks: What is a DAO?

The content of this page was updated in July 2019, with an excerpt from the book Token Economy by Shermin Voshmgir.

Blockchain and smart contracts are governance technologies that have the potential to provide higher levels of transparency while re- ducing bureaucracy with self-enforcing code. They can minimize existing principal-agent dilemmas of organizations and subsequent moral hazards. Tokens of distributed networks hereby provide incentives to automatically align interests in the absence of third parties.

DAOs tackle an age-old problem of governance, which political scientists and economists refer to as the principal-agent dilemma. This occurs when the agent of an organization has the power to make decisions on behalf of, or impacting, the principal – another person or entity in the organization. Examples hereof could be managers that act on behalf of shareholders or politicians that act on behalf of citizens. In such setups, moral hazard occurs when one person takes more risks than they normally would, because others bear the cost of those risks. More generally, it occurs when the agent acts in his own interest rather than the interest of the principal because the principal cannot fully control the agent‘s actions. This dilemma usually increases when there is underlying information asymmetry at play.

In traditional companies, all agents of a company have employment contracts that regulate their relationship with the organization and with each other. Their rights and obligations are regulated by legal contracts and enforced by a legal system which is subject to the underlying governing law of the country they reside in. If anything goes wrong, or someone does not stick to their end of the bargain, the legal contract will define who can be sued for what in a court of law.

DAOs, on the other hand, involve a set of people interacting with each other according to a self-enforcing open-source protocol. Keeping the network safe and performing other network tasks is rewarded with the native network tokens. Blockchains and smart contracts hereby reduce transaction costs of management at higher levels of transparency, aligning the interests of all stakeholders by the consensus rules tied to the native token. Individual behaviour is incentivized with a token to collectively contribute to a common goal. Members of a DAO are not bound together by a legal entity, nor have they entered into any formal legal contracts.21 Instead, they are steered by incentives tied to the network tokens, and fully transparent rules that are written into the piece of so ware, which is enforced by machine consensus. There are no bilateral agreements. There is only one governing law – the protocol or smart contract – regulating the behaviour of all network participants.

As opposed to traditional companies that are structured in a top-down manner, with many layers of management and bureaucratic coordination, DAOs provide an operating system for people and institutions that do not know nor trust each other, who might live in different geographical areas, speak different languages, and therefore be subject to different jurisdictions. Instead of legal contracts managing the relations of the people, in the Bitcoin Network, all agreements are in the form of open-source code that is self-enforced by majority consensus of all network actors. DAOs do not have a hierarchical structure, except for the code. Once deployed, this entity is independent of its creator and cannot be censored by one single entity, but instead by a predefined majority of the organization’s participants. The exact majority rules are defined in the consensus protocol or the smart contract, and will vary from use case to use case. In some countries, like Austria for example, there are trends in the legal literature to see DAOs as a civil law partnership.

A DAO can be formalized by a smart contract. Use cases range from simple to complex. The complexity depends on the number of stakeholders, as well as the number and complexity of processes within that organization that will be governed by the smart contract. Depending on the purpose and governance rules

of the organization, these use cases can have a resemblance to companies or nation-states. The more centralized governance rules are, the more it resembles a traditional company. In a more decentralized setup, the governance rules might resemble nation-states, automatically steering behaviour with tokenized incentives and disincentives. In such cases, the token governance rules incentivize and steer a network of actors without centralized intermediaries, thereby replacing the need for top-down organizations managed by a group of people, with self-enforcing code. Such decentralized organizations can use the legal system for some protection of physical property, but such usage is secondary to the preemptive security mechanisms smart contracts o er. A complex stack of technologies, steered by consensus protocols, has to be put in place in order to create a functioning autonomous infrastructure. Their native protocol tokens enable distributed Internet tribes to emerge.

DAOs are open-source, thus transparent and, in theory, incorruptible. All transactions of the organization are recorded and maintained on a blockchain. Interests of the members of the organization are – if designed correctly – aligned by the incentive rules tied to the native token. Proposals take the primary way for making decisions within a DAO, which are voted for by majority consensus of involved network actors. As such, DAOs can be seen as distributed organisms, or distributed Internet tribes, that live on the Internet and exist autonomously, but also heavily rely on specialist individuals or smaller organisations to perform certain tasks that cannot be replaced with automation. We will likely see many more DAOs, with a wide range of purposes, evolve on top of the technology that Bitcoin once pioneered. In combination with the "Internet of Things," smart property governance can also be integrated into the blockchain directly, potentially allowing decentralized organizations to control vehicles, safety deposit boxes and buildings.

The Bitcoin Network can be considered to be the first true decentralized and autonomous organization, coordinated by a consensus protocol which anybody is free to adopt. It provides an operating system for money without banks and bank managers, and has stayed attack resistant and fault-tolerant since the first block was created in 2009. No central entity controls Bitcoin, which means that as long as people keep participating in the network, only a worldwide power outage could shut down Bitcoin. The underlying blockchain protocol enables an incentive network, powered by the governance rules tied to its cryptographic token. These token governance rulesets of the consensus layer allow for automated and transparent coordination of a disparate group of people who do not know or trust each other. The Bitcoin Network has shown that tokens can be used as a means of programming behaviour, aka steering the economic behaviour of network nodes. This incentive mechanism has proven to be a motivator in performing services to a network (read more: Purpose-Driven Tokens).

With the emergence of the Ethereum Network, the concept of DAOs moved up the technology stack from blockchain protocol to the smart contract. Whereas before one needed a blockchain network with an attack-resistant consensus protocol to create a DAO, smart contracts made the creation of DAOs easily programmable, o en with just a few lines of code, and without the need of setting up your own blockchain infrastructure.

"The DAO" in 2016, for example, was a very early example for such a complex smart contract on the Ethereum blockchain. The purpose of "The DAO" was to provide an autonomous vehicle for fund management without traditional fund managers. During a four-week token sale, "The DAO" issued DAO tokens against ETH, collecting an equivalent of 150 million USD, resulting in the biggest token sale at its time. "The DAO" tokens were fungible, which means that they could be traded for any other tokens listed on a token exchange. The idea was that every DAO token holder would be a co-owner of this decentralized investment fund proportional to the number of tokens held, and could participate in investment decisions with proportional voting rights. Specialized services to "The DAO" could be conducted by subcontractors hired by "The DAO" token holders by majority consensus. However, due to a programming error in the so ware, this vision of "The DAO" never became reality, as the project was drained of roughly a third of its funds before it became operational. This led to a controversial hard fork of the Ethereum blockchain. One of the major shortcomings was that "The DAO" did not account for who is accountable for decision making in the case of unforeseen events (read more here).

I would like to argue that there is no such thing as a fully decentralized and autonomous organization. Depending on the governance rules, there are different levels of decentralization. While the network might be geographically decentralized, and have many independent but equal network actors, the governance

rules written in the smart contract or blockchain protocol will always be a point of centralization and loss of direct autonomy. DAOs can be architecturally decentralized (independent actors run different nodes), and are geographically decentralized (subject to different jurisdictions), but they are logically centralized (the protocol). The question of how to upgrade the code – when and if necessary – is very often delegated to a set of experts who understand the techno-legal intricacies of the code, and therefore represent a point of centralization.

Full text and high-resolution graphics available as paperback & ebook: Token Economy, by Shermin Voshmgir, 2019

Available: https://blockchainhub.net/dao-decentralized-autonomous-organization/